

Agricultural Finance Review

<i>Royer</i> : Cash Flow Comparisons of Qualified and Nonqualified Allocations of Cooperative Patronage Refunds	1
<i>Penson</i> : Evaluating Financial Trends in Agriculture	14
<i>Robison, Koenig, and Kelsey</i> : Farm Real Estate Prices and the Tax Reform Act of 1986	21
<i>Gustafson, Saxoulsky, and Braaten</i> : Economic Impact of Laws That Permit Delayed or Partial Repayment of Agricultural Debt	31
<i>Lines and Morehart</i> : Financial Health of U.S. Farm Financial Businesses in 1984: A Region, Type, and Size Analysis	43
<i>Lins, Ellinger, and Lantz</i> : Measurement of Financial Stress in Agriculture	53
<i>Rossi</i> : Cattle Feeding Investments: The Impact of the Tax Reform Act of 1986	62
<i>Lenneux</i> : The Impact of Federal Budget Deficits on the Cost of Agricultural Credit	72
<i>Moss, Featherstone, and Baker</i> : Agricultural Assets in an Efficient Multiperiod Investment Portfolio	82
<i>Brubaker and Frey</i> : Analyzing Change: The Statement of Changes in Financial Position	95
<i>Ellinger and Barry</i> : The Effects of Tenure Position on Farm Profitability and Solvency: An Application to Illinois Farms	106
<i>Thompson and Whiteside</i> : Effects of Market Channels on Prices of Farm Land in South Carolina	119
<i>Hughes and Osborn</i> : Measuring Federal Farm Credit Subsidies	125
<i>Robison, Lins, and Koenig</i> : Refinancing Agricultural Loans	135
<i>Barry and Robison</i> : Portfolio Theory and Financial Structure: An Application of Equilibrium Analysis	142

PREFACE

Agricultural Finance Review provides a forum for presentation of research and discussion of issues in agricultural finance. This regular annual publication contains articles contributed by scholars in the field and refereed by peers. Publication is annual except for special issues. A special issue of volume 47 was published in March 1987.

Volume 43 was the first to be published at Cornell University. The previous forty-two volumes were published by the U.S. Department of Agriculture. AFR was begun in 1938 by Norman J. Wall and Fred L. Garlock whose professional careers shaped much of agricultural finance research for many years. Professional interest in agricultural finance has continued to grow, involving larger numbers of people and a greater diversity in research topics, methods of analysis, and degree of sophistication. We are pleased to be a part of that continuing development. We invite your suggestions for improvement in *Agricultural Finance Review*.

The effectiveness of this publication depends on its support by agricultural finance professionals. That support has grown each year in terms of manuscripts received and reviews of manuscripts. Twenty-eight manuscripts were received for this volume, and fifty-seven individuals provided reviews—some more than one. We express thanks to those whose names are listed below. Grateful appreciation is also expressed to the Economic Research Service, USDA, for partial financial support. In addition, page charges and Myers Estate funds support this publication.

VOLUME 47 REVIEWERS

DeeVon Bailey	Craig Dobbins	Ralph Hepp	Philip Raup
Timothy Baker	William Dobson	Jim Johnson	John Reynolds
Freddie Barnard	Damona Doye	Eddie Kaiser	James Richardson
Michael Belongia	Mark Drabenstott	William Lazarus	Edward Rister
Larry Bitney	Richard Duvick	David Leatham	Lindon Robison
Bruce Bullock	Vernon Eidman	Warren Lee	Noel Russell
Oral Capps, Jr.	Ken Erickson	Catharine Lemieux	Roger Selley
Hoy Carman	Allen Featherstone	David Lins	Steven Sonka
George Casler	Lynn Forster	Ross Love	Bernard Tew
David Chicoine	Richard French	Harry Mapp	Richard Todd
David Cobia	Thomas Frey	Wesley Musser	John van Blokland
Robert Collins	Gregory Hanson	Mark Newman	Andrew Vanvig
Roger Conway	Edward Harshbarger	Clair Nixon	Odell Walker
David Debertin	Wayne Hayenga	John Penson, Jr.	Paul Wilson
Ray Dietrich		James Plaxico	

Manuscripts will be accepted at any time, but the final date for manuscripts for the 1988 issue is February 8, 1988.

Cash Flow Comparisons of Qualified and Nonqualified Allocations of Cooperative Patronage Refunds

Jeffrey S. Royer

Abstract

Nonqualified allocations offer an alternative to the method of allocating patronage refunds used by most farmer cooperatives. A simulation model was used to compare patron after-tax cash flows from qualified allocations with nonqualified allocations. This paper reports that the results are sensitive to changes in several parameters, and they suggest that neither method is clearly superior. Because of tax timing differences, present values of cash flows from nonqualified allocations often are comparatively greater than nominal values. Cooperatives may make less use of nonqualified allocations because managers and directors do not consider present values in making allocation decisions.

Key words: cooperative finance, patronage refunds, taxation, equity retirement, simulation model.

Federal income tax treatment of farmer cooperatives generally provides for patronage refunds to be taxed once, at either the cooperative or the patron level. That treatment was clarified in 1962 with enactment of Subchapter T of the Internal Revenue Code. Subchapter T defines the tax treatment of most cooperatives and the conditions under which a cooperative deducts certain patronage refund allocations in determining its federal taxable income. The patron to whom an allocation is made must agree to include it in current ordinary income if it is to qualify for deduction from the cooperative's income. In addition, at least 20 percent of the allocation must be paid in cash. Allocations that meet the conditions for deduction are called qualified allocations, and they are the method of allocating patron equity normally used by most cooperatives.

Subchapter T also specifies a second type of allocation, the nonqualified allocation. Nonqualified allocations are noncash allocations that patrons do not agree to accept as current ordinary income. Therefore, those allocations do not qualify for exclusion from the cooperative's taxable income. However, a cooperative does deduct cash it pays to redeem nonqualified allocations. A patron who receives cash in redemption of a nonqualified allocation includes it in taxable income.

Nonqualified patronage refund allocations offer farmer cooperatives an alternative method for allocating patron equity that may have advantages in some situations. Because patrons do not recognize nonqualified allocations for tax purposes until they are redeemed in cash, nonqualified allocations can be used to avoid negative cash flows due to tax on qualified allocations. Some patrons may wish to delay receiving income

Jeffrey S. Royer is program leader, finance, Cooperative Management Division, Agricultural Cooperative Service, U.S. Department of Agriculture. He gratefully acknowledges helpful comments by James Baarda, Michael Kane, Charles Kraenzle, Roger Wissman, and two anonymous reviewers.

and would therefore prefer nonqualified allocations. Nonqualified allocations also offer cooperatives an additional tool for tax planning, tax management, and handling losses.¹

Shortly after enactment of Subchapter T, accountants and others began writing about and planning for use of nonqualified patronage refunds. Many cooperatives changed their bylaws to permit nonqualified patronage refunds without understanding their potential uses (Thomas and Nilsestuen, p. 34). After a quarter century, only a small percentage of U.S. farmer cooperatives have used nonqualified allocations.²

This paper describes cash flow comparisons of qualified and nonqualified patronage refund allocations generated with a computer simulation model. First, a base simulation is described outlining general characteristics of qualified and nonqualified allocations and financial and economic relationships between the cooperative and patrons. Second, data from the simulation are reconstructed to describe relationships between an individual patron and the cooperative that are hidden when analyzing group data. Third, parameter values used in the simulation are changed one at a time to isolate the effects of the parameters.

Analyses used the federal tax rules in effect at the beginning of 1986. Those rules allow an interesting examination of graduated personal and corporate rate structures and the use of investment tax credit by cooperatives.³ They also were the rules in effect when recent choices were made between qualified and nonqualified

allocations. Any attempt to explain the preference of cooperatives for qualified allocations must take into account the tax environment in place when the allocation decisions were made. Effects of the Tax Reform Act (TRA) of 1986 are summarized in a later section.

Methodology

The simulation model used in this analysis generates annual cash flow and tax data for a cooperative and its patrons given preselected values of several important parameters: (a) percentage of qualified patronage refunds paid in cash, (b) average patron marginal personal income tax rate, (c) cooperative's rate of return to equity, (d) cooperative's rate of growth in equity, (e) average patron discount rate, (f) cooperative's initial net worth, and (g) cooperative's initial annual investment and replacement of capital assets qualifying for investment tax credit.

The model is based on a first-in, first-out revolving fund plan.⁴ Each year equity allocated during the year is added to the revolving fund to be redeemed in turn. Equity redeemed during the year is the residual of net margins less cash patronage refunds, income tax, and planned equity growth. Nonqualified allocations redeemed are determined by a complex procedure incorporating the corporate tax rate schedule, the investment tax credit schedule, and the additional cash flow resulting from the tax deduction for redemption of nonqualified

¹For general information on the use and advantages of nonqualified allocations, see Royer and Wissman.

²Ten of the hundred largest U.S. farmer cooperatives reported making nonqualified allocations at the end of their 1985 fiscal years. Those allocations represented 8.2 percent of total patronage distributions made by the hundred cooperatives (Davidson and Royer, p. 11). Examination of annual reports indicates some nonqualified allocations reported actually were nonpatronage-source income allocated to members and considered "nonqualified" because they did not qualify for exclusion from cooperative taxable income under Subchapter T. Comparisons with earlier data (Griffin et al.) suggest use of nonqualified allocations is growing but figures for the hundred largest cooperatives overstate general use.

³Although TRA of 1986 generally eliminated investment tax credit for property placed in service after 1985, special rules for the use of investment credit by cooperatives still exist as section 46(h) of the Internal Revenue Code. Under those rules, cooperatives cannot carry unused investment credit backward or forward to other tax years like other firms. Instead credit not used by a cooperative in the year earned is allocated to patrons on a patronage basis. Those rules have not received much analytical attention although they could again become operative if investment credit incentives are reinstituted during a future recession.

⁴According to Brown and Volkin (p. 8), 90 percent of all cooperatives with systematic plans for redeeming patron equity used the revolving fund plan. In the plan, retained patronage refunds provide net worth of the cooperative. Older equities are redeemed, usually at the discretion of the board of directors and according to the financial condition of the cooperative. For details, see Cobia, et al. (pp. 22-25).

allocations.⁵ The revolving period may vary from year to year according to the cooperative's ability to redeem equity given current net margins and cash flows.⁶

The initial revolving fund is constructed using a model reported by Cobia et al. (p. 210). In that model, the length of the revolving period is a logarithmic function of the percentage of patronage refunds paid in cash, the rate of return to equity, and the rate of growth in equity. Using the selected values of those parameters, the simulation model in this study computes the revolving period and determines the amount of equity allocations for each year of the revolving fund according to the initial net worth specified for the cooperative. Once the simulation begins, the subsequent operation of the revolving fund and the length of the revolving period are determined according to cash flow.

The simulation model generates data for two practices: (a) distributing cooperative net margins to patrons in the form of cash and noncash qualified patronage refund allocations, and (b) distributing cooperative net margins to patrons in the form of noncash nonqualified patronage refund allocations. In analyzing the nonqualified practice, it is assumed the cooperative had previously distributed patronage refunds in qualified form and is switching to a practice of allocating nonqualified patronage refunds.

There are two reasons for that assumption. First, this scenario is the most relevant because most cooperatives currently allocate patronage refunds in qualified form. Use of nonqualified allocations would require a

switch from use of qualified allocations. Second, the scenario is useful in analyzing an important stage in implementing a practice of allocating nonqualified patronage refunds, namely, the period during which the cooperative is allocating nonqualified patronage refunds and retiring previous allocations of qualified patronage refunds. That period could potentially cause financial strain for a cooperative because it must pay tax on nonqualified allocations but does not yet receive tax benefits from redeeming them.

Parameter values for the base simulation are presented in the footnote to Table 1. Because cooperatives are financially diverse, no attempt is made to choose parameter values representative of a specific type of cooperative. Instead reasonable values are chosen to demonstrate important concepts and relationships. The analyses presented here are not intended to apply generally to all cooperatives. Results for a specific cooperative will depend on the parameter levels for that firm.

Impacts on Cooperative and Patrons

Table 1 presents results of the base simulation for the qualified and nonqualified submodels for a fifty-year period. The cooperative earns a total of \$7.2 million in net margins in both models during the simulation period. Twenty percent of net margins in the qualified model are distributed to patrons as cash patronage refunds. Remaining net margins are allocated as noncash qualified patronage refunds and placed into the revolving fund. In the nonqualified model, all net margins are allocated as nonqualified patronage refunds.

One half of net margins goes into equity growth in both models. Net margins remaining after paying income tax and cash patronage refunds are used to retire patron equity. The cooperative retires approximately \$2.2 million of patron equity in both models. The cooperative in the nonqualified model redeems \$100,000 of qualified allocations issued prior to the switch to nonqualified allocations.

The cooperative in the nonqualified model generates a tax liability of \$1.6 million

⁵This represents the solution of three equations for three unknowns. The corporate tax rate schedule and investment tax credit applied at the cooperative level are nonlinear functions. Nonqualified allocations redeemed from the additional cash flow due to the tax deduction are the sum of an infinite geometric series.

Under Subchapter T, the cooperative's tax in the year nonqualified allocations are redeemed is the lesser of: (a) the tax for the current year after deducting the redemption from taxable income, or (b) the tax for the current year without the deduction less the reduction of taxes that would have occurred in prior years if the allocation originally had been issued as qualified. Because net margins are strictly increasing in the model, the first method is used and always results in the greatest tax savings. However, existence of two methods of calculating tax savings implies flexibility in tax management that is not explored here.

Table 1. Comparison of Qualified and Nonqualified Models, Fifty-Year Simulations*

Item	Nominal Values		Present Values	
	Qualified Model	Nonqualified Model	Qualified Model	Nonqualified Model
	<i>Dollars</i>			
Cash Patronage Refunds	1,447,589.86	0	81,983.63	0
Patronage Refund Allocations	5,790,359.41	7,237,949.27	327,934.52	409,918.15
<i>Net Margins</i>	7,237,949.27	7,237,949.27	409,918.15	409,918.15
Equity Growth	3,618,974.70	3,618,974.70	204,959.08	204,959.08
<i>Patron Equity Retired</i>				
Qualified Allocations	2,171,384.71	100,000.00	122,975.45	53,540.79
Nonqualified Allocations	0	2,081,290.02	0	103,451.42
<i>Total</i>	2,171,384.71	2,181,290.02	122,975.45	156,992.21
<i>Cooperative</i>				
Taxable Income	0	5,156,659.25	0	306,466.73
Tax Liability	0	1,678,949.52	0	61,630.81
Investment Credit Applied	0	241,264.97	0	13,663.94
<i>Tax Paid</i>	0	1,437,684.55	0	47,966.87
<i>Patrons</i>				
Taxable Income	7,237,949.27	2,081,290.02	409,918.15	103,451.42
Tax Liability	1,809,487.32	520,322.51	93,163.21	23,511.69
Investment Credit Applied	241,264.97	0	12,421.76	0
<i>Tax Paid</i>	1,568,222.35	520,322.51	80,741.45	23,511.69
Patron After-Tax Cash Flow	2,050,722.22	1,660,967.52	124,217.63	133,480.53

*Percentage qualified cash patronage refunds = .20, patron marginal tax rate = .25, rate of return = .15, rate of growth = .075, discount rate = .10, initial net worth = \$100,000, initial qualified property = \$5,000. Annual investment and replacement of capital assets qualifying for investment tax credit assumed to grow at same rate as net worth.

because it issues nonqualified allocations for which there is no tax deduction until redemption. Investment tax credit earned by the cooperative is applied against that tax, but tax paid by the cooperative is \$1.4 million—about the same as the cash drain due to cash patronage refunds in the qualified model.

Patron tax liability is greatest in the qualified model. Patrons receive \$7.2 million in taxable income—\$5.2 million more than in the nonqualified model. The difference in tax liability is a result of the timing difference in tax treatment. Because qualified cash and noncash patronage refunds are taxed at the patron level when allocated, patron tax liability for the qualified model in Table 1 reflects all allocations made during the simulation. Nonqualified allocations are not taxed at the patron level until redeemed. Thus a substantial portion of the allocations made in the nonqualified model is not recognized as taxable income during the

simulation. That effect is increased by growth in the equity base.

None of the \$241,264.97 investment tax credit earned by the cooperative is passed through to patrons in the nonqualified model. The entire amount is passed through in the qualified model. That reduces the tax paid by patrons in the qualified model to \$1.6 million, an amount still \$1 million more than that paid by patrons in the nonqualified model.

Nevertheless, the \$2.1 million patron after-tax cash flow (cash patronage refunds and patron equity retired less patron income tax paid) is \$389,784.70 more in the qualified model. Although patrons in the nonqualified model pay less income tax, patrons in the qualified model receive enough cash patronage refunds to more than offset the difference in tax paid.

Nominal analysis of cash flow is limited

because it does not take into account timing differences. When the nominal values in Table 1 are converted to present values, the nonqualified model yields the greatest patron after-tax cash flow. That is due primarily to timing differences in equity retirement. The cooperative in the nonqualified model redeems more equity through year thirty-eight, after which more is redeemed by the cooperative in the qualified model. Because the cooperative in the nonqualified model redeems more equity early in the simulation, the present value of equity retired in the nonqualified model is greater than in the qualified model.

Early redemption of allocated equity in the nonqualified model is accompanied by early payment of income tax by patrons on nonqualified allocations. Thus the present value of income tax paid by patrons in the nonqualified model is proportionately higher than the nominal value although substantially less than the present value of income tax paid by patrons in the qualified model.⁶

Cooperative Income Tax and Equity Retirement

An important factor in determining patron cash flow in the nonqualified model is the cooperative marginal income tax rate. As cooperative taxable income grows, the marginal tax rate facing the cooperative usually increases according to the generally progressive corporate tax rate structure.⁷ That

⁶The preceding results are sensitive to the length of the simulation period. The cumulative present value of patron after-tax cash flow is greater for the nonqualified model through sixty-five years; after that it is greater for the qualified model. That is due in part to slower equity revolvment in the nonqualified model due to an increasingly higher average cooperative tax rate. A fifty-year simulation period was judged to be adequate for demonstrating the relationships discussed in this paper.

⁷The corporate tax rates used in this analysis are 15 percent to \$25,000, 18 percent to \$50,000, 30 percent to \$75,000, 40 percent to \$100,000, and 46 percent thereafter. An additional 5 percent tax of up to \$20,250 is imposed on taxable incomes in excess of \$1 million. That eliminates the benefit of the graduated rate structure for corporations having incomes greater than \$1,405,000. The new corporate tax rates, effective July 1, 1987, are 15 percent to \$50,000, 25 percent to \$75,000, and 34 percent thereafter. The benefit of graduated rates is phased out by an additional 5 percent tax on incomes between \$100,000 and \$335,000.

increases the cash drain on the cooperative and reduces funds available for retiring patron equity.

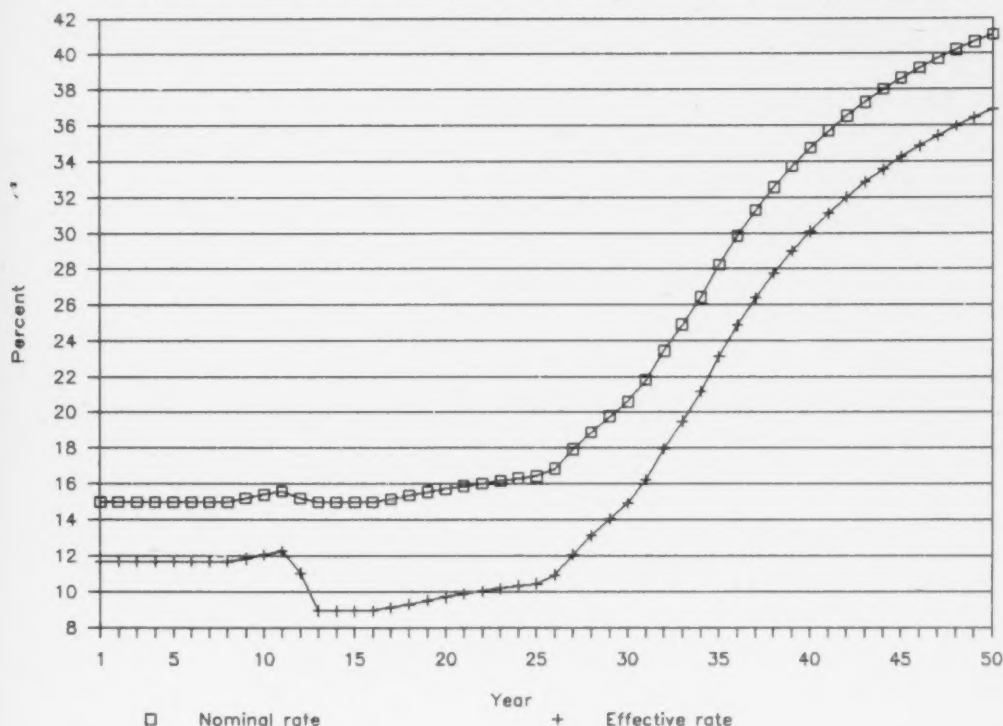
Two factors directly affect cooperative taxable income in this model—cooperative net margins and nonqualified allocations retired. There are several determinants of cooperative net margins, but assuming a constant rate of return, net margins increase as cooperative size increases due to growth. Thus cooperative taxable income generally would increase as net margins grow, but that effect is mitigated by redemption of nonqualified allocations deductible from taxable income.

Figure 1 shows the cooperative's nominal and effective average tax rates. The nominal average rate increases, decreases, and then increases following the direction of taxable income. From years one through eight, the nominal average rate is equal to the 15 percent marginal rate. With increases in net margins and taxable income, the average rate begins to increase slightly in year nine as cooperative taxable income enters the 17 percent marginal bracket. In year eleven, the average rate is 15.6 percent, but redemption of nonqualified allocations, beginning in year twelve, reduces taxable income. In years thirteen through sixteen, taxable income is again less than \$25,000, and the cooperative faces 15 percent marginal and average rates. As net margins and taxable income continue to increase with cooperative growth, the average rate increases. By year fifty, it is 41.1 percent.

Investment tax credit reduces the effective average rate and is particularly significant in early years when marginal rates are low. The effective average rate follows the nominal rate, reaching as low as 8.9 percent in years thirteen through sixteen. Eventually the effective rate increases with growth in taxable income. By year fifty, it is 36.9 percent.

The effective rates faced by the cooperative in later years represent a substantial cash drain from allocating nonqualified allocations. From year thirty-nine onward, income tax paid by the cooperative in the nonqualified model exceeds the cash drain from cash patronage refunds in the qualified model. Thus the cooperative in the

Figure 1. Nominal and Effective Cooperative Average Tax Rates, Nonqualified Model



nonqualified model is less able to retire equity than the cooperative in the qualified model.

The ability of the cooperative to redeem equity is manifested by the length of the revolving period. The revolving period in the qualified model is fourteen years throughout the simulation. In the nonqualified model, it is initially fourteen years when the cooperative redeems qualified allocations made prior to the simulation. When the cooperative switches to allocating nonqualified patronage refunds, the cash drain from income tax is at first less than that which would have occurred from paying 20 percent cash patronage refunds. That allows the cooperative to accelerate equity retirement. By year eight, the revolving period is twelve years. It remains twelve years until year thirty-five when the increased cash drain due to increasingly higher effective average tax rates results in longer revolving periods. By year fifty, the revolving period becomes seventeen years.

Impact on Individual Patrons

The effect of qualified and nonqualified patronage refunds on an individual patron's cash flow is shown in Table 2. It is assumed the patron farms for thirty-five years and is responsible for 1 percent of the cooperative's total patronage while farming.

To analyze individual data, three periods in the economic relationship between a patron and the cooperative are defined: (a) the investment period, (b) the growth period, and (c) the disinvestment period. The *investment period* starts when the patron begins doing business with the cooperative and ends when the cooperative begins redeeming the patron's equity. The patron invests equity in the cooperative but does not receive cash from the cooperative (in the nonqualified case) or may be subject to a cash drain from income tax (in the qualified case). Thus the investment period may be a period of low or negative cash flows.

Table 2. Comparison of Qualified and Nonqualified Models from Individual Patron Perspective

Model and Period	Length of Period	Cash Patronage Refunds	Patronage Refund Allocations	Patron Equity Retired	Patron Taxable Income	Patron After-Tax Cash Flow	Present Value of After-Tax Cash Flow	Average Revolving Period
	Years				Dollars			Years
<i>Qualified Model</i>								
Investment Period	14	700.98	2,803.91	0	3,504.89	(58.41)	5.00	14.0
Growth Period	21	3,926.57	15,706.28	5,889.85	19,632.85	5,562.64	504.64	14.0
Disinvestment Period	14	0	0	12,620.34	0	12,620.34	215.97	14.0
<i>Total</i>	49	4,627.55	18,510.19	18,510.19	23,137.74	18,124.57	725.61	14.0
<i>Nonqualified Model</i>								
Investment Period	12	0	2,763.56	0	0	0	0	12.8
Growth Period	23	0	20,374.18	8,435.55	8,435.55	6,326.66	622.78	12.0
Disinvestment Period	18	0	0	14,702.19	14,702.19	11,026.65	174.15	15.2
<i>Total</i>	53	0	23,137.74	23,137.74	23,137.74	17,353.31	796.93	13.3

The *growth period* starts when the cooperative begins redeeming the patron's equity and ends when the patron quits doing business with the cooperative. In the growth period, the patron continues to invest equity in the cooperative. The investment generally increases as the patron's business with the cooperative grows. The period usually results in higher cash flows because equity retirement offsets the negative tax impacts.

The *disinvestment period* begins when the patron quits doing business with the cooperative and ends when the cooperative retires the last of the patron's equity. The period results in positive cash flows from the cooperative because tax liabilities on qualified redemptions have been previously met and tax liabilities on nonqualified redemptions do not exceed the cash flow from redeemed equity.

Figure 2 illustrates individual patron cash flows from qualified and nonqualified allocations. In the qualified model, the patron investment period is equal to the fourteen-year revolving period. During the investment period, the patron incurs a negative cash flow from investing equity in the cooperative. Cash patronage refunds and investment tax credit pass-through do not offset the cash drain due to income tax on the cash and noncash patronage refunds. The negative cash flow grows throughout the period as patronage refunds increase. Total

cash drain during the investment period is \$58.41.⁸

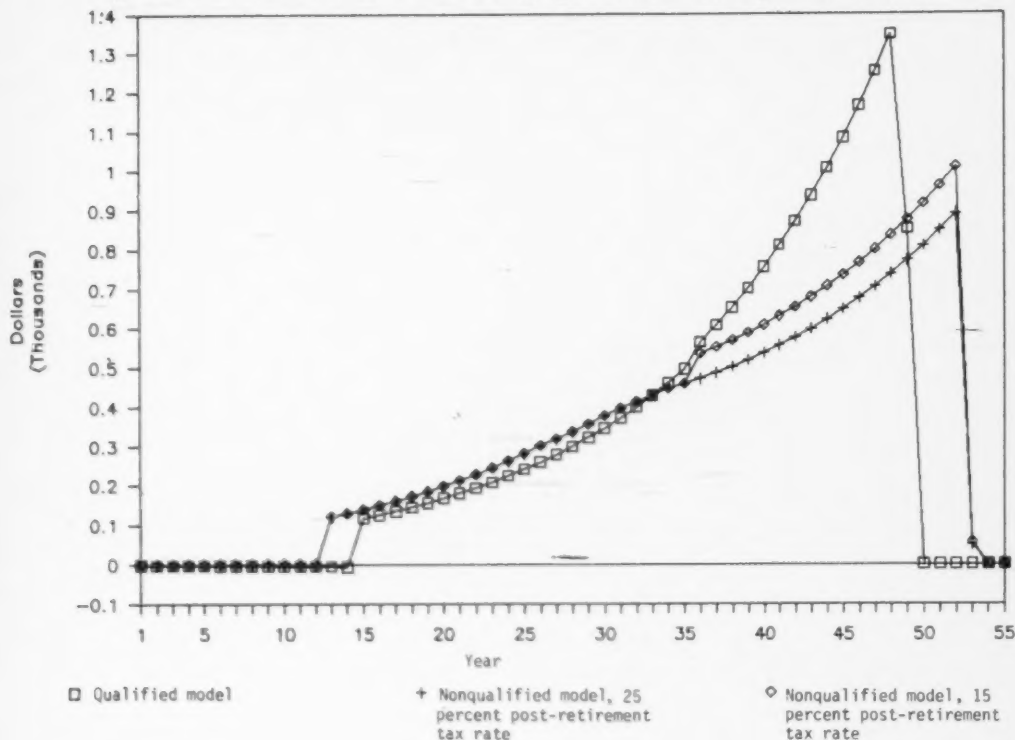
In year fifteen, the cooperative redeems patronage refunds allocated to the patron in year one, marking the start of the growth period. Redemption of previous years' equities offsets the negative cash flow from income tax on current year's allocations. Thus cash flow is positive during the growth period.

The disinvestment period begins in year thirty-six, the year after the patron quits doing business with the cooperative. During the period, redemption of the patron's equity continues, but there are no current allocations on which the patron must pay tax. Also, there are no tax consequences to the cash redemptions of equity. The disinvestment period extends for one revolving period. In year forty-nine, the cooperative revolves the last of the patron's equity.

The patron investment period is twelve years in the nonqualified model. Although the revolving period is fourteen years at the start of the simulation, it is reduced to twelve years by the eighth year. The patron's cash

⁸The present value of the cash flow actually is positive. That is because the tax liability due to receipt of a qualified patronage refund allocation is met within the following year.

Figure 2. Individual Patron Cash Flows, Qualified and Nonqualified Models



flow is zero during the period. The patron receives no cash patronage refunds, investment tax credit pass-through, or equity redemption. Neither does the patron incur a tax liability. Thus, although the patron receives no cash benefits from the cooperative, the negative cash flow arising in the qualified model is avoided.

The growth period extends from year thirteen through year thirty-five. During the period, the patron continues to receive noncash patronage refund allocations as well as redemption of previous years' allocations. Although the patron must pay income tax on nonqualified allocations redeemed, the cash redemptions ensure a positive cash flow.

In fact, cash flow during the growth period is generally greater in the nonqualified model. That is due to the generally shorter revolving period. The average revolving period during the growth period is twelve years in the nonqualified model and fourteen years in the qualified model. Total equity retirement during the patron's active farming career is

\$8,435.55 in the nonqualified model and \$5,889.85 in the qualified model.

Patron cash flow in the qualified model surpasses that in the nonqualified model in years thirty-four and thirty-five. That is because the difference in equity retired begins to shrink due to the increasingly higher marginal tax rates faced by the cooperative in the nonqualified model. At the end of the growth period in the nonqualified model, the revolving period is thirteen years and increasing.

The disinvestment period in the nonqualified model begins in year thirty-six and lasts for eighteen years—four years longer than in the qualified model. That is because of the increased revolving period due to the higher marginal tax rates. The cooperative retires \$14,702.19 patron equity during the period—\$2,081.85 more than in the qualified model. However, average annual patron cash flow is less than that in the qualified model due to the longer revolving period and the patron tax liability on nonqualified retirements.

Overall patron cash flow is greater in the qualified model. The nonqualified model yields the greatest cash flow during the patron's active farming career—during both the investment and the growth periods—but the qualified model provides the greatest cash flow during the disinvestment period. Total cash flow is \$18,124.57 in the qualified model—\$771.26 more than in the nonqualified model.

Results of the nonqualified model are superior, however, from a present value perspective. Present value of total patron cash flow is \$796.93—\$71.32 more than in the qualified model. That is because the nonqualified model yields higher present values early in the patron's career—during the investment period (when the qualified model yields negative cash flows) and during the growth period. Thus, in this case, the nonqualified model is superior from the individual patron perspective. It avoids negative cash flows during the investment period and yields a higher overall present value of after-tax cash flow.

The nonqualified model performs even better if the postretirement patron tax rate is adjusted to reflect lower taxable income common to many retirees. If the 25 percent patron marginal tax rate is replaced by a 15 percent rate during the disinvestment period, the after-tax cash flow for the period increases from \$11,026.65 to \$12,496.87. Cash flow during the period is still greater in the qualified model. However, the lower tax rate increases total patron cash flow to \$18,823.53—\$698.96 more than in the qualified model. The present value of total patron cash flow is \$817.42—an increase of \$20.49 and \$91.81 more than in the qualified model.

Effects of Parameter Changes

Effects of parameter changes on patron after-tax cash flow are presented in Table 3 for selected values of several important parameters. The following discussion is written exclusively in terms of present value analysis although Table 3 also presents nominal results.

Patron Personal Tax Rate

At low patron tax rates, qualified allocations may provide patrons higher present values

of after-tax cash flow than nonqualified allocations. Nonqualified allocations may provide the highest present values at high patron tax rates. Increases in the average patron marginal income tax rate reduce the present value of patron after-tax cash flows of both the qualified and nonqualified models, but they generally affect the qualified model more. Because qualified patronage refunds are taxed at the patron level when allocated, the cash drain occurs early and weighs heavily in present value computations. Because nonqualified patronage refunds are taxed when redeemed, the cash drain occurs later and weighs less in present values.

Discount Rate

Increasing the patron discount rate decreases the present value of patron after-tax cash flows in both qualified and nonqualified models. At low discount rates, the qualified model provides patrons with a higher present value than the nonqualified model. As discount rates are increased, the nonqualified model yields the highest present values.

That phenomenon is due to the timing of cash flows. The nonqualified model provides patrons higher nominal cash flows in early years of the simulation (years one through thirty-three) due to early equity retirement and avoidance of negative cash flows from income tax on qualified allocations. The qualified model results in higher cash flows in later years (year thirty-four onward) due to a slowdown in equity retirement in the nonqualified model because of higher cooperative tax rates. As the discount rate is increased, later cash flows weigh increasingly less in the present value calculation. Thus nonqualified allocations are more attractive to patrons who have opportunities outside the cooperative for high returns on capital. Cooperatives whose patrons have low discount rates would prefer qualified allocations.

That does not suggest nonqualified allocations will always be more attractive to patrons with high opportunity costs. This analysis shows that patrons who have high discount rates will prefer the allocation method that provides the earliest cash flows. Many factors weigh in determining the timing of cash flows.

Table 3. Effects of Parameter Perturbations on Patron After-Tax Cash Flows, Fifty-Year Simulations

Item	Nominal Values		Present Values	
	Qualified Model	Nonqualified Model	Qualified Model	Nonqualified Model
<i>Thousand Dollars</i>				
Base Simulation ^a	2,050.75	1,660.97	124.22	133.48
Patron Marginal Tax Rate				
0	3,860.24	2,181.29	217.38	156.99
.1	3,136.44	1,973.16	180.12	147.59
.2	2,412.65	1,765.03	142.85	138.18
.3	1,688.85	1,556.90	105.58	128.78
.4	965.06	1,348.77	68.32	119.37
Discount Rate				
.05	2,050.75	1,660.97	395.21	372.31
.15	2,050.75	1,660.97	60.18	68.94
.25	2,050.75	1,660.97	27.99	32.34
Investment Tax Credit ^b				
0	1,809.49	1,349.16	111.80	118.61
.5×	1,930.12	1,505.36	118.01	126.05
2×	2,292.02	1,970.70	136.64	148.18
Cooperative Size ^c				
.5×	1,025.38	1,040.99	62.11	71.30
2×	4,101.50	2,622.80	248.44	236.64
10×	20,507.52	7,867.43	1,242.18	554.53
Rate of Return				
.1	d	d	d	d
.2	3,860.24	3,470.41	229.80	240.03
.3	7,479.21	7,088.67	440.97	451.52
.4	11,098.19	10,707.26	652.14	662.73
Rate of Growth				
0	587.50	598.79	119.43	125.60
.02	824.65	853.10	122.69	130.84
.04	1,183.17	1,257.63	125.97	137.29
.06	1,669.43	1,752.74	127.42	142.50
.08	2,151.64	1,452.72	121.46	124.93
.1	d	d	d	d

^aParameter values presented in Table 1.^bExpressed as proportion of initial annual investment and replacement of capital assets qualifying for investment tax credit in base simulation.^cExpressed as proportion of initial net worth in base simulation. Investment tax credit varied by same proportion.^dNonqualified method infeasible at this level given other parameter values.

Percentage Cash Patronage Refunds

The percentage patronage refunds paid in cash does not affect the present value of total patron after-tax cash flow in the qualified model. Thus it does not affect the relative attractiveness of the qualified and nonqualified methods to patrons as a group. That is because increasing the cash patronage refunds decreases funds available for equity retirement by the same amount. Neither affects the cash drain due to patron income tax.

The percentage cash patronage refunds does affect individual patrons. The timing of cash patronage refunds and the timing of equity retirement are critical determinants of the present value of the cash flow to an individual patron. Patrons will prefer whichever practice provides them the highest cash flows. Patrons in the investment periods of their careers will prefer high cash patronage refunds. Patrons in the disinvestment period will prefer faster revivement of equity at the expense of cash patronage refunds.

Investment Tax Credit

Increasing the investment tax credit earned by the cooperative increases patron after-tax cash flows in both the qualified and the nonqualified models, but it has a greater effect in the nonqualified model. That is because increases in cooperative cash flow due to investment credit can be used to redeem additional nonqualified allocations and thereby achieve additional tax benefits. The increase in cash flow is passed on to patrons in equity retirement. Investment tax credit is more valuable not only when applied at the cooperative level against taxable income from nonqualified allocations but also as the cooperative marginal tax rate increases.⁹

Cooperative Size

In this analysis, cooperative size, as measured by initial net worth, has a significant effect on whether patrons prefer qualified or nonqualified allocations. Nonqualified allocations provide the greatest patron after-tax present value for small cooperatives. At greater amounts of initial equity, qualified allocations provide the largest present values. The improved relative performance of qualified allocations as size increases is due to the higher marginal tax rates faced by the cooperative in the nonqualified model. By assuming a constant rate of return to equity, taxable income and the marginal tax rate increase as size is increased. As the marginal tax rate increases, revivement of equity is retarded and cash flow to patrons decreases.

Rate of Return

Increasing the rate of return to equity appears to be relatively neutral in its effect on patrons' preferences between qualified and nonqualified allocations. As the rate of return increases, the present value of patron after-tax cash flow increases about the same in the nonqualified model as in the qualified model.

That differs from results for cooperative size and rate of growth. Increases in those parameters, like the rate of return, increase net margins. However, they also increase cooperative taxable income in the nonqualified model. At some point, the increased cash drain due to the progressive corporate tax structure reduces the comparative attractiveness of nonqualified allocations.

When the rate of return is increased, net margins also increase. However, an increased rate of return allows the cooperative to accelerate the redemption of nonqualified allocations issued in prior years. That lowers cooperative taxable income and delays the progressive increase in marginal tax rates. Cooperatives with higher rates of return are able to deduct redemptions of nonqualified allocations earlier and shelter a larger proportion of net margins. Once the cooperative begins redeeming nonqualified allocations, its effective average tax rates are generally less than or equal to those at lower rates of return.

Rate of Growth

The effect of the rate of equity growth on patron preferences for qualified and nonqualified allocations is complex. Increases in the rate of growth first increase and then decrease the present value of patron after-tax cash flows for both qualified and nonqualified allocations. The relative attractiveness of nonqualified allocations also increases and decreases as the rate of growth increases.

Those results are based on a number of interrelated factors. Increases in the rate of growth have two effects on patron cash flows. First, current patron cash flow is decreased because cooperative cash flow is diverted from equity retirement to equity growth. Second, an increased growth rate increases future equity and, therefore, future net margins. Thus future patron cash flows may increase because cash patronage refunds will increase when qualified allocations are issued, and equity retirement may increase when either allocation is issued.

For cooperatives that issue nonqualified allocations, the situation is complicated by

⁹Some of the increase in present value in the nonqualified model is due to timing differences between application of investment tax credit by the cooperative and patrons. In the nonqualified model, the cooperative applies investment tax credit the year it is earned. In the qualified model, the cooperative passes investment tax credit through to patrons who use it on their taxes the following year. Thus cash flow from the credit is discounted an additional year.

Table 4. Effects of Tax Reform Act of 1986 on Patron After-Tax Cash Flows, Fifty-Year Simulations

Item	Nominal Values		Present Values	
	Qualified Model	Nonqualified Model	Qualified Model	Nonqualified Model
<i>Thousand Dollars</i>				
<i>Base Cooperative^a</i>				
Before Tax Law Changes	2,050.75	1,660.97	124.22	133.48
New Corporate Rates Only	2,050.75	1,945.21	124.22	139.13
Elimination of Investment Credit Only	1,809.49	1,349.16	111.80	118.61
New Corporate Rates and Elimination of Investment Credit	1,809.49	1,669.32	111.80	125.16
<i>Large Cooperative^b</i>				
Before Tax Law Changes	20,507.52	7,867.43	1,242.18	554.53
New Corporate Rates Only	20,507.52	15,836.58	1,242.18	905.52
Elimination of Investment Credit Only	18,094.87	4,489.61	1,117.96	381.00
New Corporate Rates and Elimination of Investment Credit	18,094.87	13,094.93	1,117.96	751.87

^aParameter values presented in Table 1.

^bInitial net worth and property qualifying for investment tax credit increased to ten times that of base cooperative.

the progressive corporate tax structure, which can cause a relative decline in after-tax cash flows in later years. As the rate of growth increases, equity and net margins increase. Without a corresponding increase in the rate of return to equity, cooperative taxable income and the effective average tax rate increase. At some point, the resulting cash drain may be so great that the cooperative is unable to revolve equity.

Tax Reform Act of 1986

TRA of 1986 includes three changes relevant to the preceding analysis: (a) reduction of individual tax brackets and rates, (b) reduction of corporate tax brackets and rates, and (c) elimination of investment tax credit. The effect of changing the individual marginal tax rate has been discussed, and the maximum rates for tax years beginning in 1987 are within the range of rates presented in Table 3. In general, reductions in personal tax rates make qualified patronage refund allocations relatively more attractive to patrons.

Additional analyses were conducted to demonstrate the effects of the new corporate tax rates and elimination of investment credit. Results are presented in Table 4 for

the base cooperative used in the previous simulations and for a cooperative ten times larger. The larger cooperative was used to study the effect of lower corporate tax rates on a cooperative currently facing high marginal tax rates.

The new corporate tax rate schedule affects only the nonqualified model. Lower rates increase cash flow available for equity retirement and, therefore, both nominal and present values of patron after-tax cash flow. The effect of reduced rates is greatest for the larger cooperative. The new rates double the nominal value of patron after-tax cash flow. The present value increases by 63 percent.

Loss of investment credit lowers patron after-tax cash flow in both models but has a greater impact in the nonqualified model, particularly for the larger cooperative. That is because investment credit is more valuable to a cooperative when its marginal tax rate is higher.

The combination of reduced corporate income tax rates and elimination of investment credit decreases nominal and present values of patron after-tax cash flow in the qualified model. It increases nominal patron cash flow for both cooperatives in the

nonqualified model. It also increases the present value for the larger cooperative. However, the present value for the larger cooperative still is substantially lower than in the qualified model.

The net effect of TRA of 1986 on individual cooperatives will depend on the relative importance of the decrease in tax rates and loss of investment tax credit. Lower personal tax rates will make qualified patronage refund allocations more attractive to patrons. Lower corporate tax rates generally will make nonqualified allocations more attractive, but that effect will be partially offset by the loss of investment credit.

Conclusions

Results of the preceding analyses suggest neither method of allocating patronage refunds is clearly superior to the other. Patron cash flows and other variables are sensitive to changes in several parameters. Increases in patron marginal tax rate, discount rate, and investment tax credit may make nonqualified allocations more attractive. Increases in cooperative size, or cooperative marginal tax rate, may favor qualified allocations. Increases in the rate of return to equity are relatively neutral, and increases in the rate of growth in equity are ambiguous.

The most critical factor affecting cash flow from nonqualified allocations is the corporate tax rate. If the average cooperative tax rate is less than 20 percent, the cash drain from issuing nonqualified allocations is less than from paying qualified cash patronage refunds. However, increases in taxable income result in higher effective average tax rates that decrease equity retirement and patron cash flow. New lower corporate tax rates may diminish the effect unless they are outweighed by the elimination of investment credit.

Nonqualified allocations can be used to avoid negative cash flows that may result from qualified allocations early in a patron's farming career. Nonqualified allocations may also provide higher present values because their cash flows occur earlier in the patron's career than those of qualified allocations. If patrons expect to be in lower marginal tax brackets after retirement, nonqualified

allocations may be more attractive because much of the tax burden is shifted to postretirement years.¹⁰

Because of timing differences in the tax treatment of patronage refunds, nonqualified allocations may provide higher present values of patron after-tax cash flow in many situations where qualified allocations result in higher nominal values. One reason cooperatives have used nonqualified allocations so little may be that managers and boards of directors have not considered present values in making allocation decisions.

References

- Brown, Phillip F., and David Volkin. *Equity Redemption Practices of Agricultural Cooperatives*. Farmer Cooperative Service research report 41. U.S. Department of Agriculture, April 1977.
- Cobia, David W., et al. *Equity Redemption: Issues and Alternatives for Farmer Cooperatives*. Agricultural Cooperative Service research report 23. U.S. Department of Agriculture, October 1982.
- Davidson, Donald R., and Jeffrey S. Royer. "Top 100 Cooperatives Cut Refunds 20 Percent in 1985." *Farmer Cooperatives*, November 1986, 10-15.
- Griffin, Nelda, et al. *The Changing Financial Structure of Farmer Cooperatives*. Farmer Cooperative research report 17. Economics, Statistics, and Cooperatives Service, U.S. Department of Agriculture, March 1980.
- Royer, Jeffrey S., and Roger A. Wissman. "Nonqualified Allocations Offer Alternative Method of Retaining Funds." In *American Cooperation 1985*, 246-52. Washington, D.C.: American Institute of Cooperation, 1985.
- Thomas, John E., and Kenneth R. Nilsestuen. "Advance Planning for Redemption of Nonqualified Allocations and Retains." *Cooperative Accountant*, Spring 1980, 34-45.

¹⁰One reviewer suggested a policy of allowing patrons the option of individually accepting patronage refunds as qualified or nonqualified allocations. Patrons could choose the form that best suited their individual situations, and marginal tax rates on nonqualified allocations could be low if most patrons accepted refunds as qualified. One northeastern fruit processing cooperative has had such a policy for several years. It could substantially complicate financial planning for some cooperatives.

Evaluating Financial Trends in Agriculture

John B. Penson, Jr.

Abstract

Much attention has been given in recent years to the topic of financial stress in the farm economy. The most widely cited indicator of financial stress has been the debt-to-asset ratio. This study shows that other indicators of financial stress suggested that farmers' ability to service their farm debt was deteriorating long before the debt-to-asset ratio began to rise in the 1980s. Application of those indicators to trend analysis at the sector and subsector level is needed to monitor the ramifications of farmers' financial leverage position.

Key words: farm debt, financial stress, debt service, leverage, balance sheet, flow of funds.

Alvin Tostlebe once made the following observation: "Current financial conditions reflect a speculative, debt-financed farm boom based upon euphoric long-term income projections that later failed to materialize" (p. 111). That could be a description of the events that have taken place in the farm sector over the past ten years. Looking back at the mid-1970s, nominal interest rates had declined to the 7 to 8 percent range, inflation was making the real cost of borrowing even less, and most farmers and ranchers had enjoyed several successive good income years. In undertaking substantial debt obligations to expand the size of their operations, farmers were no doubt expecting the high real net returns, low real interest rates, and significant real capital gains they were experiencing during the 1970s to continue into the 1980s. They were not alone. Many farm experts were openly concerned about the prospect of commodity shortages in the 1980s (USDA 1981). Those farm lenders who provided the funds that made the debt expansion possible obviously held many of the same expectations.

Tostlebe actually made the above statement more than thirty years ago when describing the boom during 1915-19 and the subsequent sharp decline in net farm income over the next five years. The index of prices received by farmers ($1910-14 = 100$) fell from 211 in 1920 to 124 one year later, and it never rose above 156 during the remainder of the 1920s. Many farmers lost their farms during the 1920s because they could not meet their debt obligations (Johnson).

The historical variability of net farm income and the highly capitalized nature of commercial farming operations have obvious implications for the financial risk exposure of farm borrowers and lenders. Those characteristics suggest the need for a set of

published historical financial indicators for the farm sector that can signal impending problems associated with further farm debt expansion. As will be shown in this paper, farm lenders continued to lend substantial amounts of additional debt capital to farmers as late as 1982, well after their debt servicing ability began to decline. Part of the reason for that may well have been the lack of published historical financial indicators that could have signaled impending financial problems. Despite Tostlebe's pioneering efforts in flow-of-funds analysis, there has been too much emphasis on using balance sheet data to monitor trends in farm financial conditions.

The overall objective of this paper is to demonstrate the applicability of a *set* of historical financial indicators to monitor trends in the financial health of the farm sector. Historical information can be just as useful in diagnosing an industry as it is in medically diagnosing a patient. Whether a patient's blood pressure is rising or falling over time can be as important as its current level. Furthermore, a physician evaluating a patient's cardiovascular system to determine if he is at risk of coronary artery disease examines a variety of other indicators besides the patient's blood pressure. The U.S. Department of Agriculture (USDA) already publishes a wide variety of historical, physical, and economic indicators for the farm sector. Publications such as *Agricultural Outlook* assist a variety of interest groups in putting current conditions into perspective. However, a historical analysis of a more comprehensive set of financial indicators is needed to place current aggregate farm financial conditions into perspective. The next section of this paper briefly reviews the indicators of financial conditions currently published on a regular basis for the farm sector and assesses what they tell us and what they ignore. The third section identifies three additional financial indicators, their applicability to evaluating financial stress in the farm sector, and how they can be measured based upon *existing* data series. The fourth section illustrates the trends in those additional indicators over 1970-85 and how they signaled the impending financial difficulties that eventually surfaced in the 1980s. The fifth and last section presents concluding remarks.

Review of Currently Published Indicators

The financial stress being experienced by many farmers in recent years has led to increased analysis of their financial condition. Whether by design or due to a perceived lack of flow-of-funds data, the predominant (and often only) financial indicator used in analyzing those developments until recently has been the debt-to-asset ratio. A commonly used measure of solvency, the debt-to-asset ratio reflects the riskiness of farmers' capital structure in terms of the relationship between the capital supplied by farm lenders (debt) and the capital supplied by farmers (equity).¹ The higher the value of the ratio, the greater the degree of financial risk because lenders must be satisfied before equity owners in the event of bankruptcy. Numerous studies have used the ratio to identify those farmers who are under serious financial stress versus those who are not (USDA 1985; Johnson, Baum, and Prescott). For example, three percent of the nation's farmers in 1985 were classified as technically insolvent because their debt-to-asset ratios exceeded 100 percent. Another 7 percent were classified as nearing insolvency because their debt-to-asset ratios exceeded 70 percent (Johnson, Baum, and Prescott).

That is an entirely appropriate use of the debt-to-asset ratio because it is used in the context of evaluating insolvency. However, that ratio, when used by itself, is a poor indicator of farm cash flow problems before they become insolvency problems (Brake). As indicated in Table 1, the farm debt expansion that took place during the 1970s was surpassed by the gains in farm asset values, leaving the published debt-to-asset ratio for the farm sector largely unchanged (USDA 1986b). Only as the unrealized capital gains embodied in farm asset values began to vanish in the 1980s did concern over debt expansion become apparent. As will be demonstrated later in this paper, the burden placed upon farm income to make principal and interest payments (a precursor to

¹ The term "farmer" used in this context includes all owners of farm assets, including nonoperator landlords.

Table 1. Selected Farm Debt Characteristics, 1970-85

Year	Total Farm Debt Outstanding (Bil. Dol.)	Percent Change in Farm Debt Outstanding	Debt-to-Asset Ratio
1970	\$54.5	2.8%	16.7%
1971	59.6	9.4	16.9
1972	64.8	8.7	16.4
1973	73.4	13.3	15.3
1974	81.7	11.3	16.3
1975	91.7	12.2	15.9
1976	104.1	13.5	15.7
1977	122.9	18.1	16.9
1978	141.9	14.8	16.2
1979	166.1	17.7	16.4
1980	182.4	9.8	16.5
1981	202.1	10.8	18.2
1982	217.1	7.4	20.1
1983	216.2	-0.5	20.4
1984	212.8	-1.6	22.3
1985	204.8	-3.8	23.8

Source: *Economic Indicators of the Farm Sector*, ECIES 4-3, U.S. Department of Agriculture, January 1986.

insolvency problems and exposure to financial risk) actually began to accelerate in the mid-1970s.²

Two additional published farm financial indicators used by industry analysts are the ratios return on assets from income and return on equity from income (USDA 1986b). As indicators of farm profitability, those rates of return are thought to represent reasonably good measures of an industry's operating effectiveness (Foster). Both rates of return, however, can overstate (understate) the operating effectiveness of farmers in periods of declining (rising) asset values in an industry like farming. Changes in current market value equity in farm assets are attributed largely to *unrealized* equity gains or losses associated with changing land values rather than *realized* gains or losses associated with net income. Calculation of those farm profitability ratios, whether before or after withdrawals for unpaid family labor and management, suggests that the industry's operating effectiveness in both 1984 and 1985 was higher than in any year since 1975! Correspondingly, the index of farm land values fell between 12 and 13 percent during

1984-85. Finally, use of those rates of return in comparative analysis with other industries and in trend analysis should be interpreted with caution unless allowances are made for the relative variability in returns as well as taxes paid on earnings from farm operations.

There are a variety of other published indicators of farm financial conditions, including the number of bankruptcies and foreclosures as well as the number of voluntary and involuntary liquidations (ABA). Like the debt-to-asset ratio, those statistics highlight the magnitude of current insolvency problems as opposed to implicating trends that might ultimately lead to insolvency.

Jolly and others suggest there are "few ambiguous aggregate indicators of financial stress" (p. 1109). Yet there are several financial indicators published on a regular basis for other industries that shed light on financial stress. Deere and Company, for example, publishes for all its dealers the times interest earned ratio, which measures their ability to generate the internal funds needed to pay interest expense. Dun and Bradstreet and Robert Morris Associates also publish numerous economic and financial ratios obtained from financial statements for a variety of nonfarm industries. An assessment of farm financial trends based largely upon the published debt-to-asset ratio may not identify the buildup of financial stress in the farm sector in time for farm

² Two recent studies focused jointly on the debt-to-asset ratio and either the level of net income (USDA 1986d) or net cash flow (Jolly, and others). The analyses, however, were conducted for a particular point in time. As Lins (p. 1129) points out, negative cash flows in any one year is not a reliable measure of financial stress.

lenders and other interest groups to respond. Just as current conditions suggest the importance of lending money to farmers based upon their ability to repay from income rather than principally upon collateral considerations, the evaluation of the financial health of the farm sector should consider flow-of-funds as well as the balance sheet.³

Measurement of Additional Financial Indicators

The existence of a complete set of aggregate economic and financial indicators for farming can be helpful to short-term and long-term creditors, investors, industry analysts, and policy makers. Analysis of those indicators from both a historical as well as a pro forma perspective can focus attention on unwanted trends and help identify the farm credit policies, farm commodity policies, and macroeconomic policies that would most likely moderate those trends.⁴ This section discusses the applicability and measurement of three specific indicators of financial stress that supplement the debt-to-asset ratio and the rates of return on assets and equity from income in analyzing farm financial conditions. Several of those financial stress indicators have been used to discriminate between failed and nonfailed firms (Foster; Beaver).

Times Interest Earned Ratio

Like the debt-to-asset ratio, the times interest earned ratio assesses the leverage position

of the sector. Rather than focusing on the risk associated with the sector's capital structure at a particular point in time, however, the times interest earned ratio focuses on farmers' debt servicing ability, or their ability to pay annual interest on farm debt out of operating profit. Failure to meet that obligation can bring legal action by creditors and ultimately result in bankruptcy or foreclosure.

The times interest earned ratio was calculated in this study by dividing the sector's earnings before interest and taxes (EBIT) by farmers' total interest payments. EBIT was approximated by subtracting farm business expenses less total interest payments from net sales by farm businesses. As the value of the times interest earned ratio increases, (that is, as farmers can cover more of their interest expenses out of operating profit), farmers' exposure to financial risk as equity owners decreases. A negative value for the ratio implies negative earnings before interest and taxes.

Financial Leverage Index

One approach to using the concepts of the return on equity from income and the return on assets from income that overcomes some of the problems in measuring and interpreting those rates of return is to compute the financial leverage index. The financial leverage index addresses the issue of whether farmers benefit from the use of financial leverage rather than focusing on the specific level and variability of returns.

The value of the index was calculated in this study by dividing the return on equity from income by the return on assets from income (Fraser). If the value of the financial leverage index is greater than one, farmers' earnings per dollar of owned equity capital must necessarily be greater than the earnings per dollar on both equity and debt capital. That would suggest that farmers are employing debt capital beneficially (that is, it represents a net benefit rather than a net cost to them). It is entirely possible for the times interest earned ratio to exceed one in a year in which the financial leverage index is less than one.

Debt Burden Ratio

The debt burden ratio provides a means of

³ The point can be made that the financial indicators discussed in this paper should be applied to disaggregated homogenous subsector totals; that it would be more helpful in pinpointing the types and locations of farms in the industry that are experiencing the most financial stress. The application of financial indicators to industrywide totals, where data are more readily available, can be helpful in highlighting undesirable trends and underscoring the need for further analysis. As data permit, trends in selected subsectors within the farm sector should be evaluated using the same indicators.

⁴ There are a variety of other ratios that can be applied to the analysis of the annual financial statements published by USDA. Their description and application is beyond the scope of this paper (see Foster). There are also several indicators that cannot be calculated due to a lack of data. Those include liquidity ratios as well as such asset management ratios as accounts receivables turnover and inventory turnover.

Table 2. Selected Financial Stress Indicators, 1970-85

Year	Debt-to Asset Ratio ^a	Times Interest Earned Ratio ^b	Financial Leverage Index ^c	Debt Burden Ratio ^d
1970	16.7%	2.802	.994	31.3%
1971	16.9	2.975	.995	27.8
1972	16.4	3.657	1.019	33.4
1973	15.3	6.519	1.059	46.7
1974	16.3	4.474	1.006	40.4
1975	15.9	3.702	.968	30.2
1976	15.7	2.504	.884	26.8
1977	16.9	1.988	.855	20.8
1978	16.2	2.302	.884	23.2
1979	16.4	2.347	.861	21.1
1980	16.5	1.269	.675	19.2
1981	18.2	1.589	.748	16.4
1982	20.1	1.210	.678	16.2
1983	20.4	.537	.529	16.2
1984	22.3	1.299	.799	16.4
1985	23.8	1.253	.835	19.6

^aThis data series was calculated in Table 1.

^bThis data series was calculated by dividing earnings before interest and taxes (EBIT) by total interest payments. In 1980, EBIT of \$20.7 billion was calculated by subtracting farm business expenses less interest payments (\$113.1 billion) from net sales by farm businesses (\$113.8 billion). Total interest payments in 1980 were \$16.3 billion.

^cThis data series was calculated by dividing the rate of return on equity capital by the rate of return on total capital. In 1980, the rate of return on farm business equity from income was 2.41 percent while the rate of return on farm business assets from income was 3.57 percent.

^dThis data series was calculated by dividing net cash farm income (cash farm business income minus cash farm business expenses) by total farm debt. In 1980, cash farm business income was \$143.3 billion, cash farm business expenses was \$108.2 billion, and total farm debt outstanding was \$182.4 billion.

assessing the burden placed upon working capital from operations to retire debt obligations (Foster). The ratio is calculated by dividing net cash farm income by total farm debt outstanding. As the value of that ratio decreases, greater stress is placed upon farm earnings after debt servicing to retire farm debt outstanding on schedule. As the percentage rises, the farmers' perceived ability to repay their principal indebtedness will increase.

An alternative specification of the ratio would call for the inclusion of net cash income rather than net cash farm income in the numerator. It would account for the potential use of nonfarm earnings to retire farm debt. That specification is not calculated in this paper, however, due to the lack of data on nonfarm debt owed by farmers.

Data Availability

The data necessary to compute each of the above ratios are available on a regular (annual) basis from several government publications. Information from the farm

sector's balance sheet and income statement are available in *Economic Indicators for the Farm Sector* (USDA 1986a). The data necessary to compute the financial leverage index are available from several published sources (USDA 1986a and 1986b; Melichar). As the USDA's *Farm Cost and Returns Survey* continues to gather financial information for farmers that can be disaggregated by specific characteristics, industry analysts will have the basis for calculating and analyzing trends in those financial stress indicators at the subsector level as well (Johnson, Baum, and Prescott).

Trends in Farm Financial Indicators

Table 2 presents the annual values for the three indicators of financial stress described in the previous section plus the annual values of the widely cited debt-to-asset ratio for 1970-85. While the debt-to-asset ratio varied little during the 1970s (it never deviated more than one percentage point from its mean of 16.3 percent), the other

financial stress indicators showed considerable volatility about their means (3.327, .953, and 30.2, respectively). The times interest earned ratio, the financial leverage index, and the debt burden ratio all indicated a marked improvement over 1972-74, when interest rates declined and gross farm income rose. As the use of debt capital rose during the mid- to late-1970s (as shown in Table 1) despite the presence of rising real interest rates and declining real net farm incomes, the sector's exposure to financial stress began to grow. The sector ended the decade with a times interest earned ratio that was 29 percent below its mean during the 1970s. The financial leverage index in 1979 was 10 percent below its mean and the debt burden ratio was 30 percent below its mean. That deterioration is in sharp contrast to the condition of the debt-to-asset ratio, which ended the decade less than 1 percent from its mean. The decline in the financial leverage index during 1975-79 is even more significant when compared with its rating during 1950-69, when it *never* fell below one.

Total debt outstanding rose an additional 30 percent between the end of 1979 and the end of 1982 despite a sharp decrease in farmers' debt servicing and repayment ability. At least part of the reason for the continued buildup of real estate and nonreal estate farm debt in the sector can be attributed to a refinancing of current liabilities taking place during the period to overcome cash flow problems. Another reason may have been the continued preference by some farm lenders to consider loans primarily on the basis of collateral instead of cash flow feasibility. Farm land values had not yet begun to fall, calling into question the wisdom of collateral lending.

By 1983, the times interest earned ratio actually fell below one, indicating that farmers in general were not able to service their farm debt commitments. The financial leverage index and the debt burden ratio also fell to post-World War II lows. Not surprisingly, 1983 marked the first year in which debt outstanding at the end of the year was *below* previous year levels during the post-World War II period.

The rising debt-to-asset ratio during 1983-85 was not due to increasing debt levels illustrated in Table 1, but rather largely due

to declining asset values. The ability of farmers in general to make their annual principal and interest payments, however, actually improved in 1984 and 1985 as evidenced by the other three financial stress indicators. Those improvements reflect the somewhat lower interest rates during the period as well as the high levels of government payments to farmers. It again illustrates that one could draw an incomplete picture of financial conditions in the farm sector if the analysis is limited to the debt-to-asset ratio. All four indicators taken together, however, suggest that farmers in general continue to be in a weaker financial position than at any time during the 1970s.

Concluding Remarks

This paper demonstrates the applicability of a set of financial stress indicators to analyzing information contained in the published sector financial statements. It is shown that each of the three aggregate financial stress indicators examined in this study signaled the buildup of financial stress in the sector long before the debt-to-asset ratio began to rise.

The additional ratios can be applied at the firm, subsector, or sector level. The more aggregated are the financial statements used to calculate those indicators, the more biased their interpretation will be. In applying those indicators to sector-level balance sheet, income statement, and cash flow data, we have focused on the *general trends* in financial stress rather than on the specific level of a particular ratio. Those general trends call into question the continued buildup of farm debt in the sector during 1980-82. The same indicators should be applied to historical subsector data whenever possible.

References

- American Bankers Association. *1985 Midyear Farm Credit Survey*. Washington, D.C., 1985.
- Barry, Peter J. *Financial Stress in Agriculture: Policy and Financial Consequences*. AE-4261. Illinois Agricultural Experiment Station, November 1986.

Beaver, W.H. "Financial Ratios as Predictors of Failure." In *Empirical Research in*

Accounting, supplement to *Journal of Accounting Research*, March 1968, 71-111.

Brake,* John R. *A Perspective on the Financial Situation in Agriculture*. Staff paper no. 86-19. Cornell University Agricultural Experiment Station, July 1986.

Deere & Company. *Dealer Comparative Management Review*. Moline, Illinois, various issues.

Dun & Bradstreet, Business Economics Division. *Key Business Ratios*. New York, various issues.

Foster, George. *Financial Statement Analysis*. 2nd ed. Englewood Cliffs, NJ: Prentice-Hall, 1986.

Fraser, L.M. *Understanding Financial Statements*. Reston, VA: Reston Publishing Company, 1985.

Johnson, H. Thomas. *Agricultural Depression in the 1920's*. New York: Garland Publishing, 1985.

Johnson, Jim, Kenneth Baum, and Richard Prescott. Financial Characteristics of U.S. Farms, January 1985. U.S. Department of Agriculture AIB 495, July 1985.

Johnson, Jim, Mitchell J. Morehart, and Kenneth Erickson. "Financial Condition of the Farm Sector and Farm Operators." *Agr. Fin. Rev.* 47 (1987 special issue): 1-18.

Jolly, Robert W., Arnold Paulsen, James D. Johnson, Kenneth H. Baum, and Richard Prescott. "Incidence, Intensity, and Duration of Financial Stress Among Farm Firms." *Amer. J. of Agr. Econ.*, December 1985, 1108-15.

Lins, David A. "Financial Stress Among Farm Firms: Discussion." *Amer. J. of Agr. Econ.*, December 1985, 1129-30.

Lins, David A., and Danny Klinefelter. "Omissions in Measuring Farm Sector Wealth and Income." *N. C. J. of Agr. Econ.* 4, (1982): 9-17.

Melichar, Emanuel. *Agricultural Finance Databook*. Division of Research and

Statistics, Board of Governors of the Federal Reserve System, June 1986.

Robert Morris Associates. *Annual Statement Studies*. Philadelphia, various issues.

Tostlebe, Alvin. *Capital in Agriculture: Its Formation and Financing Since 1870*. Princeton: Princeton University Press, 1957.

U.S. Department of Agriculture. *Agricultural Outlook*. AO-123, September 1986.

_____. *Will There Be Enough Food?* 1981 Yearbook of Agriculture.

U.S. Department of Agriculture, Economic Research Service. *The Current Conditions of Farms and Farm Lenders*. AIB 490, March 1985.

_____. *Economic Indicators of the Farm Sector*. ECIFS 4-3, January 1986a.

_____. *Agricultural Finance Outlook and Situation Report*. AFO-26, March 1986b.

_____. *Financial Characteristics of U.S. Farms, January I, 1986*. AIB 500, August 1986c.

_____. *Financial Well-Being of Farm Operators and Their Households*. Report no. 563 prepared by Mary Ahearn. September 1986d.

Farm Real Estate Prices and the Tax Reform Act of 1986

Lindon J. Robison, Steven R. Koenig, and Myron P. Kelsey

Abstract

This article used recently constructed maximum bid and minimum sell price models to predict analytically and measure empirically the effects of the Tax Reform Act (TRA) of 1986 on farm real estate prices. Model results indicate that losing the preferential tax treatment of capital gains along with the increased tax life of depreciable assets and loss of investment tax credits (ITC) may lower farm real estate maximum bid prices by 13 to 17 percent and minimum sell prices by 5 to 8 percent.

Key words: farm real estate prices, maximum bid price, minimum sell price, Tax Reform Act of 1986.

TRA of 1986 changes many of the tax rules that apply to farm real estate investments. Those changes affect the amount of taxes paid on both operating income and capital gains income. Farm real estate accounts for roughly 70 percent of the value of U.S. farm sector assets, thus any changes that could affect the value of that asset base are of significant interest.

This article predicts the impact of the new tax law on farm real estate prices using newly developed maximum bid and minimum sell price models. The models allow us to examine how the new tax law will affect both buyers and sellers of farm real estate. They show that in most cases buyers and sellers of farm real estate will be affected differently by the new tax laws.

Several recent studies offer explanations of land prices and returns.¹ Although the contributions of the studies are interesting and useful, they are not directly relevant to this study for two reasons. First, they do not include depreciable asset purchases in their models, and second, they lack sufficient detail to model the most relevant features of the new tax law. In addition, most of the models above are tested *ex post* using actual market data. Obviously, data sets do not yet exist to test the effects of the TRA of 1986.

The genealogy of the maximum bid and minimum sell price models used in this article to examine the new tax law is as follows. Lee and Rask introduced a maximum bid price model for land with a

Lindon J. Robison and Myron P. Kelsey are professors in the Department of Agricultural Economics, Michigan State University. Steven R. Koenig is an agricultural economist with the Economic Research Service, U.S. Department of Agriculture. The authors thank John R. Brake and two anonymous reviewers for their helpful comments on an earlier draft of this paper. Michigan Agricultural Experiment Station journal article no. 12304.

¹See, for example, studies by Alston; Barry; Barry and Robison; Burt; Brown and Brown; Castle and Hock; Doll; Widdows, and Velde; Duncan; Espel and Robison; Feldstein; Klinefelter; Lowenberg-DeBoer and Boehlje; Melichar; Pope; Pope, Kramer, Green, and Gardner; Phipps; Plaxico; Peterson; Robison, Lins, and Venkataraman; Scott; Shalif and Schmitz; Tweeten; White and Ziemer; and Whitmore to name a few.

finite horizon and with capital gains income accruing independent of operating income. Their model accounts for taxes in the income and cost stream but does not include tax adjustments in the discount rate. Especially useful in their model is the inclusion of financial arrangements. This feature in their model shows how different financial arrangements may alter the maximum bid price for land.

Lee and Rask make no explicit reference to the minimum sell price of sellers, leaving the impression it is equal to the maximum bid price. Neglecting the minimum sell price may be partially warranted because transactions costs are ignored. Nevertheless, the capital gains tax paid by the seller would have precluded the two approaches, yielding the same answer.

Baker constructed a maximum bid price model for land that in some respects is unique and improves on the Lee and Rask model. Baker derives his model analytically using geometric series instead of describing it in terms of numerical sums. That approach allows for comparative static analysis of model results, although Baker does not use his model for that purpose.

Baker's model solves for an infinite number of buyers, each holding the land for a finite period. That approach makes capital gains a function of the rate of growth in income rather than being exogenously determined as it is in the Lee and Rask model. Baker includes taxes in the income and cost stream as do Lee and Rask, and he adjusts the discount rate by the marginal income tax rate, which Lee and Rask fail to do. Like Lee and Rask, though, Baker ignores the seller's side of the market, but unlike Lee and Rask, he omits any financial arrangements from the model.

Robison and Burghardt constructed land pricing models, using five present value principles. Their five principles led them to construct an infinite life model as Baker did. They also constructed it analytically, and they introduce a limiting assumption to obtain versions of their models that can be used for comparative static analysis. The comparative static results can not be obtained from Baker's model or from their own models unless the limiting assumption is employed.

Following Baker's lead, which is consistent with their homogeneity of measurements principle, Robison and Burghardt adjust the discount rate on a marginal income tax basis. They also introduce transactions costs and taxes specific to buyers and sellers. And like Lee and Rask, they include financial arrangements in the models. By including those variables, their number of models increases from a single maximum bid price model to five minimum sell price models and two maximum bid price models.

Robison, Koenig, and Kelsey (hereafter referred to as RKK) generalized the Robison and Burghardt models by allowing for the purchase-sale of depreciable assets to be included with the purchase-sale of land. They also generalize the Robison and Burghardt models in the manner in which taxes are applied to the discount rate. The RKK models are used in this paper to predict responses to the TRA of 1986.² A significant feature of the RKK models that suits the purposes of this paper is that tax parameters in the model can be adjusted to reflect major tax law changes. By varying those parameters one can predict deductively, using comparative static analysis, the direction of the changes in real estate prices resulting from the new tax law. By substituting numbers from case studies, the models can be solved numerically to determine the magnitude of the changes.

With the following, this article describes the provisions of the TRA of 1986 that are most significant to farm real estate investors. Then the RKK models are reviewed and used to predict numerically and analytically farm real estate price responses to several major tax law changes. Finally, this article concludes with a summary of the results and a discussion of their implications.

Highlights of the TRA of 1986

Kelsey, Robison, and Koenig report that the most significant changes of the new tax law affecting real estate values include the following: (a) the lowering of marginal tax brackets, which alters net after-tax income; (b) the loss of exclusion on capital gains

²The complete model is reported in Robison, Koenig, and Kelsey. The limited versions of the models are presented here to simplify the exposition.

income; (c) the loss of ITC, which increases the after-tax cost of farm investments subject to the ITC; and (d) the changes in depreciation schedules that affect the deferral of taxable income.

After-tax net income is a major determinant of the value of an investment and is the theoretical basis of capitalization formulas. The new tax law reduces maximum individual income tax rates from 50 percent to 28 percent. There is a one-year (1987) phase-in period for the rates.³ The maximum corporate income tax rate is lowered from 46 to 34 percent. These changes should have a positive effect on investment values by increasing after-tax income for the same before-tax income levels. However, by reducing marginal tax rates, alternative investments may become more attractive. How the tax code change alters the relative effective tax rates between farm real estate and alternative investments will be important in determining how farm real estate values respond to that specific change in the tax law.

Under the new tax law, the 60 percent exclusion of capital gains income from taxable income has been eliminated. For assets sold under the old rules, the maximum effective income tax for an individual in the 50 percent tax bracket was 20 percent. The same taxpayer will now pay tax on capital gains income at the top individual rate. The loss of capital gains exclusion should lower real estate bid prices.

ITCs were actually repealed retroactive to January 1, 1986.⁴ Uncertainty about their implementation, however, means that much of their effects on farm real estate prices would not have been experienced until late 1986. ITCs have the effect of reducing the after-tax cost of investments. Reduced investment costs result from the direct deduction from income taxes of the ITCs received. The 10 percent credit was available

on machinery and equipment, grain storage structures, specialized livestock structures, drainage tile, fences for livestock, and other capital assets.

The repeal of the ITC did not reduce the ITC received by the sellers of real estate, so their minimum sell price was affected little, if at all. On the other hand, the maximum bid price offered by buyers will be reduced by nearly all of the ITC. Therefore the tax code change will have very little effect on the seller's minimum sell price but will reduce significantly the buyer's maximum bid price. That could reduce the liquidity of real estate because buyers and sellers will have a more difficult time agreeing on a price.

The accelerated cost recovery system (ACRS) has been modified by the new law. Depreciable asset recovery periods (tax life) have been increased, reducing the tax benefits of depreciation. For capital purchases after 1986, most three-year property becomes five-year property and most five-year property becomes seven-year property. Some real estate assets affected by the new recovery periods include: drainage tile, fences, livestock facilities, grain storage structures, and other qualifying specialized farm structures. For general purpose farm structures, the tax life is increased to twenty years.

Although depreciable asset recovery periods lengthen under the new law, depreciation rates for many assets have been accelerated. The acceleration reduces some but not all of the negative impact on real estate prices of increasing the depreciable tax life.⁵

Many investors, however, may choose not to use the modified ACRS schedule due to the new accounting rules for the capitalization of preproductive costs. Those rules apply to the development of new orchards-vineyards and the raising of replacement breeding livestock. Accounting problems can be avoided by choosing the alternative depreciation system (ADR), which uses a ten-year straight-line depreciation rate.

³The maximum rate for the 1987 phase-in year is 38.5 percent. There is a 5 percent surcharge that adjusts the rate for certain income classes beginning in 1988. The top marginal rate for those classes increases from 28 percent to 33 percent.

⁴For certain financial leases ITC is still available, and unused credits can be brought forward but in gradually declining percentages.

⁵Most assets qualify for a 200 percent declining-balance depreciation rate, while orchards and vineyards and general purpose farm structures qualify for a 150 percent rate.

There are other tax law changes that will have an effect on farm real estate prices that are not considered here. They include: limitations on using losses from farming to shelter other income, new interest limitations, limitations on land clearing expense deductions, restrictions on deductions for the prepayment of farm expenses, and an increase in the Section 179 deduction from \$5,000 to \$10,000 for farm businesses with capital investments of less than \$200,000 per year. Those changes apply less generally than those discussed earlier and are therefore not considered further in this paper. On the other hand, it should be noted that they might be significant where the tax code changes are applicable.

Construction of Maximum Bid and Minimum Sell Price Models

Maximum bid and minimum sell price models are special cases of present value models. Comparative static analysis requires comparisons at equilibrium. Equilibrium is guaranteed for the firm in maximum bid and minimum sell price models because the firm's opportunity cost of capital, reflected by its discount rate, must equal the internal rate of return of the investment under consideration. Or, stated another way, the net present value of maximum bid and minimum sell models is zero making the maximum (minimum) bid (sell) price the most (least) a buyer (seller) can offer (accept) and still earn the after-tax rate of return equal to the discount rate.

The discount rate for the buyer reflects the firm's cost of capital used to finance the investment. If the funds used to finance the investment are borrowed, then the discount rate is the rate of interest associated with borrowing. If the funds used to finance the purchase are obtained from equity or the liquidation of other assets, then the discount rate is the rate of return foregone plus adjustments for liquidation costs. Or if combinations of debt and equity are used, then the discount rate for the buyer is an appropriately weighted average of the two sources of funds.

When constructing maximum bid and minimum sell price models, it is important

that the tax rate associated with the discount rate corresponds to the tax rate associated with the source of funds. The tax rate associated with equity funds acquired by the liquidation of a tax-free bond, for example, would be zero while the tax rate associated with funds obtained from borrowing would be the firm's marginal income tax rate.

For the seller, the discount rate has a different interpretation. The discount rate reflects the rate of return expected to be earned on the funds invested from the sale of the real estate. Again, the appropriate tax rate incorporated in the discount rate reflects the investment opportunity being considered.

One cannot always infer market price fluctuations from changes in the maximum bid and minimum sell price model results. In many cases, such an inference requires first an aggregation over the individual market participants.⁶ However, when maximum bid and minimum sell prices for individuals move in the same directions in response to tax law changes, the effect on the market price will be unambiguous and can be reported.

Before proceeding further with the models, some caveats are in order. First, it is not possible for any model constructed for analytical purposes to do more than capture the essential details of the tax law changes. Thus, the results derived here must be considered tentative. Individual tax effect questions will require more detailed analysis than the models presented here are capable of delivering. For example, the models used in this paper use only straight-line depreciation methods that most closely approximate the tax consequences of TRA of 1986 for investors with the capitalization of preproductive costs. ACRS, of course, could have been used but would have been difficult to manage analytically.

With those limitations in mind, a maximum bid price and a minimum sell price model are reported. We begin by describing the variables used in the model. Some of the

⁶Robison, Lins, and Venkataraman illustrate how one might aggregate over individual maximum bid price models to obtain theoretically consistent market results.

variables influencing buyers and sellers of real estate are

- r = a real rate of return available to the firm on its investments,
- T = the constant proportional income tax rate,
- α = the capital gains tax rate (valued at .4 prior to 1987) equals 1 under the new tax law,
- T_p = real estate taxes as a percent of the nominal real estate value,
- i = the general rate of inflation implicit in the discount rate,
- g = the rate of change in the returns from the real estate within an ownership period that must include the effect of changes in the productivity of land and any attached depreciable asset(s),
- R = net cash returns from the real estate in the first period,
- n = the length of time the real estate will be owned by current and subsequent owners,
- s = the percentage of the real estate's acquisition price paid as a realtor's fee,
- c = the percent of the real estate's acquisition price paid as a loan closing fee, including title fees, attorney costs, and closing points paid,
- V_o = real estate price paid by the seller when originally acquired,
- D_o = current period market value of the depreciable asset(s) attached to the land,
- n_d = tax life of the depreciable asset(s),
- n_o = age of the seller's depreciable asset(s) or the number of years it has been in service,
- $n_o^* = n_d$ if $n_d \leq n_o$, or n_o if $n_d > n_o$,
- D_o = original price of the depreciable asset(s) when placed in service n_o periods ago,
- $T^* = T$ if current year (e.g., 1986) less $n_o > 1987$ or αT if current year (e.g., 1986) less $n_o < 1981$,
- d = a parameter determining the percentage decline in the remaining useful life of the depreciable asset,

δ = a tax adjustment coefficient applied to the discount rate.⁸

The variable d determines the useful life of the depreciable asset. The useful life and the change in the rate of returns determine the value of the depreciable asset(s) exchanged between buyer and seller in future periods. Thus, some discussion of its empirical significance is in order. The value $(1+d)^t$, where t is the number of elapsed time periods, approaches zero asymptotically as t gets large so that it gets close but never reaches zero. One could ask, however, how many periods are required for the depreciable asset to be reduced to 5 percent of its original real value?

Such an expression would satisfy the equation

$$.05 \geq (1+d)^{-t} \quad (1)$$

RKK, in addition to the variables described above, include financial variables depending on the financial arrangements worked out between the buyer and seller. They are omitted from consideration here to more clearly focus attention on the effects of the TRA of 1986.

Using the variables defined above, RKK solve for a maximum bid price V and a minimum sell price of V_s for real estate. If n is allowed to become an extremely large number, the analytic expressions for V and V_s can be written as shown in the box.

Analytic results, when they can be obtained, help validate models. Analytic results

⁸For example, suppose $n_o = 3$, that is, the depreciable asset is three years old at sale time. Then $1986 - n_o = 1983 > 1980$ and $T^* = T$. That condition in the model is required to model earlier tax law changes.

⁹It is important that both the discount rate and the income and cost stream be adjusted for taxes. The question is, what tax rate should be used to adjust the discount rate? The answer is, the tax rate that applies to the next best investment opportunity. If the next best investment opportunity is a financial instrument whose returns are taxed at the firm or individual's income tax rate T , then the appropriate tax adjustment is to multiply the rate of return by $(1-T)$. If the next best investment is a tax-free bond, then the appropriate discount rate is the rate of return on the bond unadjusted for taxes. Finally, if the next best investment opportunity is an asset whose returns are partially shielded from income tax, the appropriate tax rate by which the discount rate is adjusted is $(1-\delta T)$ where $0 < \delta < 1$. Setting $\delta = 1$ or $\delta = 0$ models the tax adjustment required for financial instruments and tax-free bonds, respectively.

$$\begin{aligned} \lim_{n \rightarrow \infty} V = & \left[R(1-T) \div \{ (r+i+ir)(1-\delta T) - g \} (1+c) + T_p(1-T) \right] \\ & + .1D_a \\ & + \left[(.95) D_a (1+c) T \{ 1 - [1 + (r+i+ir)(1-\delta T)]^{-n_d} \} \div \right. \\ & \left. - [n_d (r+i+ir)(1-\delta T)] \{ (1+c) + \frac{T_p(1-T)}{[(r+i+ir)(1-\delta T) - g]} \} \right] \quad (2) \end{aligned}$$

and

$$\begin{aligned} \lim_{n \rightarrow \infty} V_s = & \left[R(1-T)(1+c) \div \{ [(r+i+ir)(1-\delta T) - g](1+c) + \right. \\ & \left. T_p(1-T)(1-s)(1-\alpha T) \} \right] - \left[D_a T \div \right. \\ & \left. \{ (1-s)(1-\alpha T) n_d (r+i+ir)(1-\delta T) \left[1 + \frac{T_p(1-T)}{(r+i+ir)(1-\delta T) - g} \right] \} \right] \\ & - \left[\frac{\alpha T(1+c)V_o}{(1-s)(1-\alpha T)} \right] + \left[\frac{\alpha T(1+c)D_{ao}(n_o^*/n_d)}{(1-s)(1-\alpha T)} \right] \quad (3) \end{aligned}$$

indicate how maximum bid or minimum sell prices will respond to changes in selected parameters or variables. The directions of change can then be empirically checked in the more complete models and can also be checked against intuition.

The complexity of the models with finite holding periods, however, precludes their analytic examination. As a result, analytic uses of the models required a simplifying assumption, namely, that the holding period n was very large. In all but one case, comparative static results conform to the direction of the results obtained from solving the models empirically using case study numbers. Moreover, the results have an acceptable intuitive explanation.

We know one exception where the analytic and empirical model results are inconsistent; that is, the capital gains tax parameter α is changed in the maximum bid price model. The buyer never sells the real estate when n is very large, and no capital gains tax is paid on the sale. Thus, the maximum bid price is unaffected by changes in the capital gains tax parameter. In all other cases, the limit

versions of the model and the empirical versions of the model provide consistent results in response to changes in model parameters and variables.

The parameters of interest in equations 2 and 3 describe tax changes that approximate those initiated by the new tax law. Consider first the elimination of the preferential tax treatment given to capital gains. Analytically that is tested in equations 2 and 3 by an increase in α . Under the new law, α is increased from .4 to 1. The results are

$$dV/d\alpha = 0 \quad (4a)$$

$$\text{and} \\ dV_s/d\alpha \leq 0 \quad (4b)$$

Increasing α has no effect in the limiting version of the maximum bid price model but would reduce V if the holding period is finite. Increasing α for the seller when the sale of real estate earns capital gains income reduces the after-tax profit from the sale. If the same rate of return is to be earned as reflected in the discount rate, then V_s must increase. But if the sale of real estate results in capital losses, then increasing α increases

tax credits and allows the firm to lower V_s and still earn the rate of return reflected in the discount rate.

If V_s is greater than or equal to V and increases, and V decreases or remains the same, then the difference between the maximum bid price and the minimum sell price is increased, and sales of real estate will be less likely to occur as a result of the elimination of the preferential tax treatment of capital gains. The effect on the market price of real estate in response to an increase in α , however, cannot be predicted because V and V_s move in opposite directions.

Next consider the effect on the maximum bid price and the minimum sell price resulting from an increase in the tax life of depreciable asset(s). They are

$$dV/dn_d < 0 \quad (5a)$$

$$dV_s/dn_d < 0 \quad (5b)$$

Increasing the tax life of the depreciable asset(s) n_d reduces the present value of the tax shield created by depreciation.⁹ Therefore V is reduced. Likewise, increasing n_d reduces the present value of the tax shield from continued ownership of the real estate by the seller. As a result, V_s decreases as well.

Because the firm's equilibrium price has been reduced for both the seller and the buyer, it is difficult to determine how real estate sales will be affected. One can infer, however, that because the response to an increase in n_d is in the same (negative) direction for both V and V_s , the result will reduce the market price of real estate.

The third effect examined analytically is the change in the income tax rate. For many investors, the new tax code will mean a reduction in their marginal income tax rates. Reduction of income tax rates has an

ambiguous effect on the maximum bid price and on the minimum sell price of real estate. They are ambiguous not only because the tax rate that applies to earnings from farm real estate is lowered but also because the tax rate is lowered in the discount rate. Reducing the income tax rate increases the after-tax discount rate while increasing the after-tax income from real estate. The net effect is to leave ambiguous the changes in V and V_s .

The final tax impact considered here is the repeal of the ITC. It has been considered in more detail by Kelsey, Robison, and Koenig elsewhere. They found the loss of ITC would reduce the maximum bid price. Moreover, the percentage reduction in the maximum bid price would depend on the percentage of the real estate value attributable to depreciable assets.

Empirical Results of the RKK Models

The combined effects of the tax law changes described earlier and deduced analytically are now reported. In doing so, versions of the models less limiting than those described in equations 2 and 3 are used. In the less restrictive models, n is no longer required to be infinite, but finite, making the repeal of the preferential tax treatment of capital gains of some consequence to the buyer as well as to the seller. The examples to be constructed are on a per acre basis to simplify comparisons of real estate values before and after the TRA of 1986.

Maximum Bid Price Example

Consider the maximum bid price that could be offered for a 100-acre tract of land with the following characteristics. Attached to the land are single-purpose farm structures (eligible for five-year or seven-year ACRS classification) that have an appraised market value of \$750 per acre. The structures are seven years old (placed into service in 1981) and their useful life declines at 18 percent per year.

Purchase of the asset is expected to produce a constant real cash return of \$125 per acre in the first year. Growth in the cash returns from inflation or productivity improvement is projected at 1 percent per year. The estimated holding period of the new asset is

⁹The model used in this paper has one significant change from the model developed by RKK, which was used by Kelsey, Robison, and Koenig. The inflation rate applied to the market value of depreciable assets is g , the inflation rate applied to net cash returns, rather than i , the general inflation rate in the economy. That change ties the market value of depreciable assets to farm earnings rather than price changes in the general economy.

ten years. Although possibly eligible for the ACRS depreciation method, the optional straight-line depreciation capital cost recovery method is selected.

Real estate tax on the nominal value of the land plus the attached depreciable structures is 2.5 percent. Acquisition cost (title preparation, title insurance, legal fees, and so forth) is 1 percent of the purchase price and is paid by the purchaser. The realtor's fee is 5 percent and is paid by the seller.

Under the previous tax laws, the \$750 in depreciable assets would be eligible for an investment tax credit of 10 percent or \$75. In using the full benefits of the tax credit, the depreciable bases of the assets are required to be reduced by one-half of the credit taken. Therefore, the depreciable base is reduced by \$37.50 to \$712.50. Further, special purpose agricultural structures are allowed to be depreciated in just five years.

Profits from the sale of the property in future years are eligible for the capital gains exclusion, which requires that only 40 percent be included as taxable income. Now consider two different firms, firm A and firm B, that wish to bid on the real estate. Firm A has a marginal tax rate of 33 percent, while firm B has a marginal tax rate of 50 percent. Both firms are structured as sole proprietorships.

It is assumed that alternative investments will provide the two firms with a real rate of return of 3.5 percent while the inflation rate implicit in the discount rate is 4 percent. Using pre-1986 tax law, the maximum bid price for the farm real estate is \$1,525 for firm A and \$1,632 for firm B.

Under the TRA of 1986, the tax life is increased, the capital gains provision is eliminated, the ITC is eliminated, and the marginal tax rates are lowered to 15 percent for firm A and 28 percent for firm B for 1988 after the 1987 phase-in period. Those changes reduce the tax shield of the depreciable asset and lower the maximum bid price from \$1,525 to \$1,327 for firm A, a decline of 13 percent. Meanwhile the maximum bid price for firm B is reduced from \$1,632 to \$1,356, a decline of 16.9 percent.

Minimum Sell Price Example

From the seller's perspective, the repeal of the capital gains rules is the most significant feature of the new tax law. To illustrate the results of the new tax law for sellers, we assume that instead of buying the 100 acres of real estate, firms A and B are selling it. We also assume that they acquired the asset at the peak of farm real estate values, paying \$2,200 per acre for the land and attached depreciable assets. The cost of the specialized farm structures was \$1,400 per acre. For simplicity and comparison, we assume the firms selling the farm asset are structured the same as in the purchase examples and that firms A and B are still in the same tax brackets as when they were purchasers.

If the asset was sold under the old tax laws, the minimum sell price is \$1,430 for firm A and \$1,436 for firm B. With the new tax rules, the minimum sell price decreases to \$1,362 for firm A and decreases to \$1,321 for firm B.

The decreases occur because of capital losses experienced by the sellers. Under the new tax law, tax credits from capital losses are increased. The results for both the buyer and the seller are summarized in Table 1.

Table 1. Summary of the Changes

	Maximum Bid Prices		
	Old Law Results	New Law Results	% Change
Firm A	\$1,525	\$1,327	-13
Firm B	\$1,632	\$1,356	-16.9
	Minimum Sell Prices		
	Old Law Results	New Law Results	% Change
Firm A	\$1,430	\$1,362	-4.8
Firm B	\$1,436	\$1,321	-8

Summary and Conclusions

This article uses recently constructed maximum bid price and minimum sell price models to examine the effects of the TRA of 1986 on farm real estate prices. The RKK models indicate that under typical case study conditions, maximum bid real estate prices would fall somewhere between 13 and 17 percent. That decline is primarily a result of the loss of preferential tax treatment of

capital gains, the loss of ITC, and deferred depreciation deductions. The seller's minimum sell price, on the other hand, would decline 5 to 8 percent under those case study conditions, a result attributable to the loss of the preferential tax treatment on capital gains.

The decrease in the marginal income tax rate does not offset the negative pressures on farm real estate prices exerted by the increase in the capital gains tax, the loss of investment tax credit, and by the increases in the tax life of depreciable assets. The reduction in the income tax rates may not offset those negative pressures because the marginal tax rate on farm real estate may not be reduced relative to the effective tax rate on investments that are alternatives to farm real estate.

Much more work remains to be done to understand completely the effects of the TRA of 1986. It is clear, for example, that the proportions of the asset's price attributable to depreciable assets is an important variable determining the response of real estate values to the new tax law.

One issue to consider in connection with the new tax law is the perception of the real estate investors. For example, if any of the provisions of the tax law changes are considered temporary in nature, then their impact will be less pronounced.

Finally, a market model aggregated over individuals would surely be useful to determine if the micro impacts argued here carry over to market results. Those and other areas of work still need attention.

References

- Alston, Julian M. "An Analysis of Growth of U.S. Farmland Prices, 1963-82." *Amer. J. of Agr. Econ.* 68(1986):1-9.
- Baker, Timothy G. *An Income Capitalization Model of Land Values with Income Tax Considerations*. Journal paper no. 47907. Purdue Agricultural Experiment Station, June 1981.
- Barry, Peter J. "Capital Asset Pricing and Farm Real Estate." *Amer. J. of Agr. Econ.* 62(1980):547-53.
- Barry, Peter J., and Lindon J. Robison. "Pricing and Rates of Return for Depreciable Versus Nondepreciable Assets: The Case of Farmland." *Land Economics* 62(1986):388-401.
- Brown, Keith C., and Deborah J. Brown. "Heterogeneous Expectations and Farmland Prices." *Amer. J. of Agr. Econ.* 66(1984):164-69.
- Burt, Oscar R. "Econometric Modeling of the Capitalization Formula for Farmland Prices." *Amer. J. of Agr. Econ.* 68(1986):10-26.
- Castle, Emery N., and Irving Hock. "Farm Real Estate Price Components, 1920-78." *Amer. J. of Agr. Econ.* 64(1982):8-18.
- Doll, J.P., R. Widdows, and P.D. Velde. "The Value of Agricultural Land in the United States: A Report on Research." *Agr. Econ. Research* 35(1983):39-44.
- Duncan, Marvin. "Farm Real Estate Values—Some Important Determinants." *Monthly Review*. Federal Reserve Bank of Kansas City, March 1977.
- Espel, Thomas K., and Lindon J. Robison. *A Conversation Between Buyers and Sellers of Land, or a Market-Equilibrium Approach for Estimating Land Values*. Agricultural Economics report no. 403. Michigan State University, December 1981.
- Feldstein, Martin. "Inflation, Portfolio Choice, and the Price of Land and Corporate Stock." *Amer. J. of Agr. Econ.* 62(1980):910-16.
- Kelsey, Myron P., Lindon J. Robison, and Steven R. Koenig. "Effect of the 1986 Tax Law on Maximum Bid Real Estate Prices." *J. of the Amer. Soc. of Farm Managers and Rural Appraisers* 51(1987):30-33.
- Klinefelter, Danny A. "Factors Affecting Farmland Values in Illinois." *Illinois Agr. Econ. Res.* 13(1973):27-33.
- Lee, Warren F., and Norman Rask. "Inflation and Crop Profitability: How Much Can Farmers Pay for Land?" *Amer. J. of Agr. Econ.* 58(1976):984-90.
- Lowenberg-DeBoer, J., and Michael Boehlje. "The Impact of Farmland Price Changes on

- Farm Size and Financial Structure." *Amer. J. of Agr. Econ.* 68(1986):838-48.
- Melichar, Emanuel. "Capital Gains Versus Current Income in the Farming Sector." *Amer. J. of Agr. Econ.* 61(1979):1085-92.
- Peterson, Willis. "Land Quality and Prices." *Amer. J. of Agr. Econ.* 68(1986):812-19.
- Phipps, Tim T. "Land Prices and Farm-Based Returns." *Amer. J. of Agr. Econ.* 66(1984):422-29.
- Plaxico, James S. "Implications of Divergences in Sources of Returns in Agriculture." *Amer. J. of Agr. Econ.* 61(1979):1098-1102.
- Pope, C. Arden, III. "Agricultural Productive and Consumptive Use Components of Rural Land Values in Taxes." *Amer. J. of Agr. Econ.* 67(1985):81-86.
- Pope, Rulon D., Randall A. Kramer, Richard D. Green, and B. Delworth Gardner. "An Evaluation of Econometric Models of U.S. Farmland Prices." *W. J. of Agr. Econ.* 4(1979):107-19.
- Robison, Lindon J., and William G. Burghardt. *Five Principles for Building Present Value Models and Their Application to Maximum (Minimum) Bid (Sell) Price Models for Land*. Michigan Agricultural Experiment Station journal article no. 11051, November 1983.
- Robison, L.J., S.R. Koenig, and M.P. Kelsey. *Maximum (Minimum) Bid (Sell) Price Models for Land When Depreciable Assets Are Included in the Transaction*. Michigan Agricultural Experiment Station journal article no. 12186, November 1986.
- Robison, Lindon, J., David A. Lins, and Ravi VenKataraman. "Cash Rents and Land Values in U.S. Agriculture." *Amer. J. of Agr. Econ.* 67(1985):794-805.
- Scott, John T., Jr. "Factors Affecting Land Price Decline." *Amer. J. of Agr. Econ.* 65(1983):798-800.
- Shalit, Haim, and Andrew Schmitz. "Farmland Accumulation and Prices." *Amer. J. of Agr. Econ.* 64(1982):710-19.
- Tweeten, Luther G. *Farmland Pricing and Cash Flow in an Inflationary Economy*. Oklahoma State University Agricultural Experiment Station research report P-811, June 1981.
- White, Fred C., and Rod F. Ziemer. "Farm Real Estate Pricing Under Risk: An Empirical Investigation." *S. Econ. J.* 49(1982):77-87.
- Whitmore, G.A. "Impact of Farm Size on the Bidding Potential for Agricultural Land." *Amer. J. of Agr. Econ.* 59(1977):385-87.

Economic Impact of Laws That Permit Delayed or Partial Repayment of Agricultural Debt

Cole R. Gustafson, David M. Saxowsky, and Joan Braaten

Abstract

Laws designed to protect delinquent farm borrowers impact creditors and nondelinquent borrowers. Total economic impact to North Dakota agricultural lenders of such laws is estimated to be \$172.2 million as of July 1, 1986. That estimate includes \$23.9 million due to collection delays before acquisition of securing collateral, \$62.2 million due to liquidation delays after acquisition, and \$60.4 million of concessions associated with negotiated settlements. Also included in the total is \$25.7 million that creditors cannot collect due to the lack of deficiency judgments. Nondelinquent farm borrowers are impacted by higher interest rates and lower capital availability.

Key words: delinquent loans, statutory law, negotiations, payment delays, partial repayment, economic impact, lender survey.

A consequence of declining commodity prices and high real interest rates is an increased level of farm loan delinquencies. Often state legislatures enact laws to assist debtors by preventing creditors from promptly collecting and liquidating collateral that secures the loans. Restricting creditors' rights during times of economic recession is not without precedent. Alston notes many state legislatures sought to aid farmers during the 1920s and 1930s by enacting laws that protect delinquent borrowers.

North Dakota laws that define the rights and limitations of credit institutions after a debtor's default are similar to those of other states. However, North Dakota statutes also include several unique provisions. For example, the "antideficiency judgment" statute limits the amount a creditor may collect after foreclosing a real estate mortgage that does not satisfy the debt (*N.D.C.C. 32-19-06*). Another law is the "confiscatory price" statute that grants state courts additional discretionary authority to delay legal proceedings such as a foreclosure if commodity market prices are below costs of production (*N.D.C.C. 28-29-04*).

Regardless of the details of such programs, the result is either a postponement of the debtor's scheduled payment or a reduction in the amount owed. The economic impact upon delinquent borrowers from a delay in repayment or a decrease in the amount owed may or may not be sufficient to permit financial recovery of the business. The correlative impact on lenders is a decrease in income and value of assets without an offsetting reduction in costs or liabilities. Lenders respond by adjusting fees and interest rates as well as by altering the level and kind of services offered. Consequently,

Cole R. Gustafson and David M. Saxowsky are assistant professors, and Joan Braaten is a graduate research assistant, in the agricultural economics department, North Dakota State University. The study was cosponsored by the North Dakota Agricultural Experiment Station and several financial institutions in the state. The authors wish to thank Larry Bitney, Thor Hertsgaard, Roger Johnson, Larry Leistritz, and an anonymous reviewer for their helpful comments. North Dakota Experiment Station paper no. 1547.

their customers are impacted by a combination of rising charges, reduced financial services, and lower capital availability. Those implications are recognized, but few studies have quantified the concessions granted to delinquent borrowers and the resulting economic impacts on lenders and nondelinquent borrowers.¹

This article estimates the economic costs incurred by creditors and nondelinquent borrowers that result from laws that permit delayed and partial repayment of agricultural loans. The study does not ascribe a cost to each article of law. Instead, laws are categorized as to their effect: permitting either delayed or partial repayments. A general model is developed in the next section that quantifies each of the financial transfers. Data to estimate the models were collected from a survey of financial institutions that offer intermediate- and long-term credit to North Dakota farmers. The North Dakota situation is used as an example, recognizing other states may have similar legislation. The resulting impact on creditors and implications for nondelinquent borrowers are presented in the following sections.

Analytic Models

Nondelinquent borrowers and creditors are impacted by laws that permit delayed or partial repayment of debt obligations by delinquent borrowers. The economic impact of such laws is defined as each agent's change in wealth. The financial transfer to delinquent borrowers is one determinant of the impact. The final economic impact depends on the level of losses that are either absorbed by creditors or passed on to other customers of the financial institutions. The analysis begins from a creditor's perspective.

Impact on Creditors

Two mathematical models were formulated to quantify the economic impact on creditors of laws that permit delayed or partial repayment of indebtedness. A model delineating the impacts associated with loan

delinquencies will be presented first, followed by a discussion of a model that estimates the impact of negotiated settlements. The two impacts are differentiated because negotiated settlements occur over a period of time (dynamic variable) whereas the level of delinquent loans can only be estimated at a point in time (a stock variable).

Of partially repaid loan delinquencies.

As loan delinquencies rise, creditors incur two types of economic costs—costs associated with repayment delays and costs of partial repayment. Partial repayment is discussed first because it influences estimation of the former. Primary focus will be upon North Dakota's "antideficiency judgment" statute (ADJ), which applies only to real estate.

The economic cost of partial repayment (*PR*) is the difference between the amount a creditor would be able to collect in the absence of ADJ and the amount the creditor receives under ADJ. Deficiency judgments following foreclosure of real estate mortgages are, for all practical purposes, not available in North Dakota. The amount a creditor collects in North Dakota as a result of the limit on deficiency judgments is the lesser of (a) the amount of debt or (b) the value of the security. If the value of the security does not satisfy the outstanding debt, creditors in states that permit deficiency judgments would be able to claim a portion of a debtor's nonexempt equity. Consequently, undersecured creditors are impacted by the law, and the amount of the impact is the lesser of (a) the collectible deficiency (a portion of nonexempt equity) or (b) debt minus the value of the security.

The definition of collectible deficiency (*CD*) is the amount a creditor can collect from a borrower after adjusting for other indebtedness and statutory exemptions. The amount of the collectible deficiency is never less than zero and depends on whether the creditor is assumed to be the last or the first creditor paid. If the creditor is the last to be paid then

$$\begin{aligned}
 CD = & \text{MAX} + \text{current assets} \\
 & + \text{intermediate assets} \\
 & - \text{current debt} - \text{intermediate debt} \\
 & - \$20,000
 \end{aligned}
 \tag{1}$$

¹Using aggregate data, Alston estimates the economic consequences of moratorium legislation during the 1930s. Lee and Baker illustrate how loan defaults raise lending costs.

where MAX is the greater of (land value - land debt - \$80,000) and (\$0). The values, \$80,000 and \$20,000 represent borrowers' exemptions under North Dakota law—their homestead and their personal possessions, respectively. If the creditor is the first to be paid, then

$$CD = MAX + \text{current assets} + \text{intermediate assets} - \text{debt secured by current assets} - \text{debt secured by intermediate assets} - \$20,000 \quad (2)$$

The impact will be greater if the creditor is assumed to be paid first. The formulas are based on two additional assumptions. The first assumption is that any equity in the land is converted to homestead property. A corollary to that assumption is that equity in personal property will not be used to reduce the land mortgage in order to maximize the homestead exemption. A second assumption is that the value of chattel a creditor acquires equals the reduction in debt; therefore, the borrower's equity in intermediate and current assets is the same before and after the creditor takes possession of the security. To avoid further respondent burden, the creditor is assumed to be the last to collect from chattel but the first creditor to collect a deficiency from any nonexempt equity in the land. That assumption recognizes that the first creditor to seize or encumber nonexempt equity in real estate will have priority.

Of delayed repayment. The second economic cost of loan delinquencies to creditors is in the form of repayment delays. Repayment delays and associated costs of loan delinquencies are categorized as (a) those that arise during the foreclosure procedure and postpone the creditor's taking control of the collateral and (b) delays in reselling the property after a creditor has acquired ownership through foreclosure or voluntary conveyance by the borrower. Therefore, the total economic impact of loan delinquencies to creditors at the state level ($SEIDL$) is specified as

$$SEIDL = \sum_{l=1}^L \left[\sum_{d=1}^D (PR_{ld} + COD_{bld} + COD_{ald}) \right] \quad (3)$$

which equals the cost of PR outlined above, the costs before acquisition of securing collateral (COD_{bld}), and the costs after acquisition (COD_{ald}) for all delinquent loans (d) in the portfolios of creditors (1) that lend to North Dakota farmers.

The distinction is necessary for two reasons. The first is that some laws (such as the "confiscatory price" statute) postpone foreclosure, whereas other laws (such as the borrower's right to redeem) limit and thereby delay a credit institution's opportunity to sell the property once it acquires ownership. The second reason for the distinction is that the value of some variables used to estimate economic impacts varies depending on when the delay occurs during the enforcement procedure. The gross level of uncollected income during the delay is an example of such a variable, and it will be more fully explained when that variable is discussed.

Costs before and after acquisition of securing collateral depend on several variables. They include gross uncollected interest (GUI , which is the amount of income that could have been earned had the payment not been delayed), the amount of income that is actually received during the delay (AR), the cost of maintaining the collateral during the delay ($MAIN$), and changes in the collateral's market value (MVC). Equation 4 illustrates the relationships between the variables. Each variable is discussed in more detail in the following paragraphs.

$$COD_{bld} = GUI - AR + MAIN + MVC, \delta = b, a \quad (4)$$

GUI is the amount of income that could have been earned had various laws not delayed repayment and is defined as

$$GUI = CP_b \times i \times DUR \quad (5)$$

Factors influencing GUI are collectible proceeds (CP_b) which is the value of property or cash that would have been received by the creditor had the delay not been implemented), the creditor's opportunity rate of return (i), and the duration of the delay (DUR).

Collectible proceeds depend on whether the debt is secured and on the type of property used as collateral. Accordingly, indebtedness can be categorized as (a) debt secured by

land or real property, (b) debt secured by chattel or personal property, (c) debt secured by both real and personal property, and (d) unsecured debt.

The collectible proceeds for debt secured by land is the lesser of the amount of debt or the value of the collateral—reflecting North Dakota's "antideficiency judgment" law. Collectible proceeds for debt that is secured by chattel is the lesser of the amount of debt or the value of the collateral plus the collectible deficiency. Collectible proceeds for debt secured by both real and personal property would be the lesser of the amount of debt and value of the security. That reflects the practice that liens on personal property are enforced first, with the real property mortgages subsequently foreclosed. The collectible proceeds when the debt is unsecured is the lesser of the amount of debt and the collectible deficiency.

The second factor affecting *GVI* is the opportunity cost of the collectible proceeds. The opportunity cost of those funds is assumed to be the interest rate on new loans. It assumes any collectible proceeds would again be loaned out.

Duration of the delay is the third factor affecting estimation of *GVI*. Estimating the economic impact of each particular law would require that the length of delay attributable to each law be known. Because the focus of the study is on laws that delay repayment in general and not on the economic consequences of each particular statute, the average duration of each delinquent loan will be used as a proxy for the delay. At any given point during the year, the proxy may be slightly biased due to the seasonality of loan delinquencies. Data to correct for that bias are unavailable.

The second variable for estimating the economic impact of a delay in repayment is the amount of income the creditor receives during the delay. That income is a benefit to creditors, and it partially offsets the amount of *GVI*. The two sources of income are from delinquent borrowers who continue to make interest payments and rental income from collateral acquired after foreclosure.

The amount of income will vary depending on whether the law postpones foreclosure or

delays resale of collateral after a creditor has ownership. If the law being analyzed postpones foreclosure, the amount of income will be the interest that accrues during the delay and is actually paid to the creditor by the borrowers. By comparison, the amount of income a creditor receives during a delay in reselling the property will usually reflect the opportunity to lease the collateral until a sale is arranged. The opportunity to lease acquired property will primarily depend on the time of the year the creditor receives ownership. In North Dakota, those opportunities are limited because borrowers' redemption privileges prevent creditors from leasing land the first year after foreclosure.

The third variable, *MAIN*, is the amount that has to be paid during the delay to maintain the value of the security. Real estate taxes are the most substantial maintenance cost incurred by lenders even though property insurance premiums and repairs are occasionally paid by a creditor. This study assumes maintenance costs are directly related to the duration of the delay.

Changes in market value of collateral (*MVC*) are a possible consequence of delays either before or after foreclosure. For example, the amount a creditor is repaid will decrease as a result of a law that delays repayment if the value of the security declines during that delay and thereby renders the creditor undersecured. Change in the amount repaid is the collectible proceeds at the inception of the delay (CP_b) minus the value of collectible proceeds at termination of the delay (CP_t) and any principal payments (*PP*) from the borrower to the creditor during the delay

$$MVC = CP_b - CP_t - PP \quad (6)$$

The definition of *CP* is dependent on the same variables described in a previous section, including the period of valuation and type of property securing the obligation. Those variables not only account for value of the collateral (collectible deficiency) but also reflect whether creditors are undersecured or fully secured.

Of negotiated settlements. An alternative to foreclosure is to resolve the delinquent loan through negotiation. By accepting a compromise, creditors and borrowers avoid litigation and its associated monetary costs,

time demands, and uncertainty. Creditors may write off accrued interest or principal owed as well as lower interest rates on the remaining balance to entice borrowers to voluntarily abandon use of legal delays. By comparison, borrowers who provide additional collateral improve the position of the creditor while adversely affecting their own.

Consequently, settlements are a factor in estimating the economic impact of a law because compromises change under alternative laws that establish the creditors' and debtors' initial bargaining positions. Combining the economic impact of negotiated settlements and the economic impact of delayed foreclosure does not double count because the two loan groups are mutually exclusive. The economic impact of negotiations is estimated as the difference between the present value of the loan prior to settlement and the present value of the obligation after settlement.² The appropriate discount rate is the interest rate of the loan at inception of the delay.

Impact on Nondelinquent Borrowers

Nondelinquent borrowers and other customers of a financial institution are also affected by laws that permit delayed or partial repayment. Such customers are impacted whenever the institution raises interest rates on loans or adds other service fees in an effort to recover lost revenue. An institution's limit on fee and interest rate increases will be determined by the level of competition. Most institutions are reluctant to reduce interest rates paid on savings because depositors can readily shift their resources to institutions offering higher returns.

A loan pricing model is specified to calculate the increased marginal cost of credit and the lower capital availability nondelinquent borrowers face under such laws. Credit institutions must generate sufficient revenue

to pay all costs if they are to exist in the long term. That implies that a lender will adjust the rate of interest charged to borrowers and the fees assessed for other services to compensate for the economic impact of state laws that permit partial or delayed repayment of indebtedness. The model is used to estimate the interest rate adjustment necessary to compensate creditors for adverse state laws.

Assuming a long-run equilibrium, total receipts are presumed to equal total costs

$$(1 - d) LY + d DY = I + L + O + E - S - F \quad (7)$$

where

LY = loan volume times average interest rate on loans not in default,

DY = loan volume times average interest rate on loans in default,

d = share of loan volume in default,

I = interest costs,

L = provision for loan losses,

O = operating expenses,

E = earnings for building reserves,

S = security income, and

F = service fees and other income.

Total receipts consist of interest income (LY) from borrowers who have not defaulted $(1 - d)$ and other income (DY) from the proportion of borrowers who have defaulted (d). Any income collected from borrowers after default is included in DY but often that value is zero. Total costs include interest costs (I) and administrative costs (L, O, E) adjusted for other income (S, F). Repayment delays represent temporary shortfalls in revenue and may be capitalized if more than one year is involved. The earnings' increment necessary to accumulate additional reserves to meet those shortfalls is represented by an increase in E .

Solving equation 7 algebraically for the level of revenue necessary to support total costs produces

²Flows associated with negotiated settlements are discounted because revenue changes over considerable periods of time could be involved. Technically, flows associated with delayed and partial repayment of delinquent loans discussed in the prior section should also be discounted. Survey data indicate the length of times involved are less than one year. Hence, for simplicity, they are considered insignificant.

$$LY = [I] + [L + O + E - S - F - DY] + \left[\frac{d}{1-d} (I + L + O + E - S - F - DY) \right]$$

Interest cost (i) = I

Administrative costs

$$(a) = L + O + E - S - F - DY$$

Risk premium (r) =

$$\frac{d}{1-d} (I + L + O + E - S - F - DY) \quad -(8)$$

Dividing both sides by the level of outstanding balances provides an estimate of the interest rate necessary to cover all costs. As shown in equation 8, the interest rate consists of three components—an interest cost (i), an adjustment for administrative costs (a), and a risk premium (r) that depends on the level of defaults (Lee and Baker). Borrower default causes the creditor to incur interest and administrative costs. A rise in the default rate significantly increases credit costs as a result of the relationship $d/1-d$.

There are also nonprice impacts on nondelinquent borrowers that affect the quantity of credit available. A rise in the price of credit (as determined by equation 8) to a level above the market rate forces lenders to ration credit to only selected borrowers if they are to control default levels and remain competitive (Stiglitz and Weiss). The consequence is reduced credit availability.

This section described the models needed to estimate the economic impact upon creditors and nondelinquent borrowers when statutory law permits delayed or partial repayment. The next section details the data collection process employed in this study and the results of the analysis.

Economic Impact on Credit Institutions

Two survey instruments were developed to elicit the information necessary for estimation of the models discussed in the previous section. Survey 1 requested specific information as of July 1, 1986, about each delinquent loan held by financial institutions that loan money to North Dakota farmers for

purchases of chattel or real estate. Data from the survey were used to estimate the total amount of delinquent debt in the state and to appraise the current status of each delinquent loan and the borrower's financial condition. Survey 2 solicited general information about each financial institution's capital structure, operating costs, and lending practices. It also gathered information about debt restructuring and negotiated settlements that occurred between January 1, 1985, and July 1, 1986.

The surveys were distributed September 5, 1986, to 180 federal, state, and independently chartered banks, four regional Farm Credit Services (FCS) offices, three savings and loans, the credit divisions of ten full- and short-line manufacturers of farm machinery, and eleven credit unions (Table 1). Those institutions hold approximately \$3.442 billion of the \$5.743 billion of agricultural credit extended to North Dakota farmers. Not included in the survey were Farmers Home Administration, Commodity Credit Corporation, and individuals holding contracts for deed, and so forth.

Table 1. Agricultural Debt Held by all North Dakota Lenders

	Millions of Dollars
<i>Real Estate Debt</i>	
Federal Land Bank	\$ 1,358.
Farmers Home Administration	353.
Life Insurance Companies	61.
Banks	100.
Individuals and Others	\$ 537.
	\$ 2,409.
<i>Nonreal Estate Debt</i>	
Banks	\$ 960.
Production Credit Association	612.
FICB	26.
Farmers Home Administration	558.
Individuals and Others	276.
Commodity Credit Corporation	902.
	\$ 3,334.
<i>Grand Total</i>	\$ 5,743.

Source: United States Department of Agriculture, Economic Research Service, 1986, *Economic Indicators of the Farm Sector—State Financial Summary*, 1984.

Initially, sixty-three institutions responded to the survey. They consisted of fifty-seven banks, four FCS offices, one savings and loan, and one machinery manufacturer. The

Table 2. Significant Differences Between Responding and Nonresponding Banks

Variable	Responding Banks		Follow-up Survey		T Test
	Mean	Std. Dev.	Mean	Std. Dev.	Statistic
Total Delinquent Loan Volume	6.45%	4.02%	4.29%	3.94%	1.99%
Agricultural Loan Volume	36.81	26.22	48.44	33.74	-1.31
Delinquent Agricultural Loan Volume	6.69	9.51	9.10	16.71	-.57

data provided information on 2,086 delinquent loans.³

A follow-up telephone survey statistically tested whether nonresponding banks had a different level of delinquent loans than banks that had responded. Seventeen banks that had not responded to the surveys were randomly selected and contacted to answer the questions of an abbreviated survey 2. Results of the tests are shown in Table 2. The total delinquent loan volume, agricultural loan volume, and delinquent agricultural loan volume are not significantly different for both groups. Variation in responses is due solely to sampling. Thus, the sample of reporting banks can be considered representative of all banks in the state. State-level estimates are derived by adjusting the survey responses for missing observations and extrapolating to the state level. Agricultural debt reported by responding lenders totals \$2.035 billion; thus an expansion factor of 1.6914 is used ($3.442/2.035$).

Delinquent Agricultural Loans

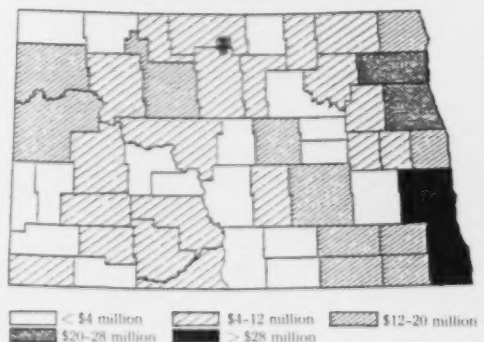
Total delinquent agricultural loan volume in North Dakota as of July 1, 1986, is estimated to have been \$466.1 million, or 13.5 percent of the state's agricultural loan volume. Figure 1 illustrates the distribution of delinquent agricultural loan volume by county. The Red River Valley, four counties in the southeast, two counties along the western border, and several counties in the midsection of the state have the most delinquent agricultural debt. Adverse weather and declining oil

income partially explain the level of delinquent loans in the southeast and western counties, respectively. One-fourth of the delinquent agricultural loans had a principal of less than \$37,500, half were less than \$83,620, and 90 percent were less than \$292,260. Most of the loans were secured (real estate, 76.6 percent; chattel, 5 percent; and both chattel and real estate, 9.5 percent).

Impact of Delayed Repayment

The economic impact of delayed repayment on lenders is a combination of gross uncollected interest (*GUI*), income received by the credit institution (*AR*), maintenance costs (*MAIN*), losses on the sale of collateral due to decreased values, and costs of negotiated settlements (Table 3). Procedures for estimating each cost are described in the following paragraphs. The estimated impact of delayed foreclosure is explained first.

Figure 1. Estimated Delinquent Agricultural Loan Volume By North Dakota Counties, July 1, 1986



³Because borrowers often have loans with more than one financial institution, the data are probably not mutually exclusive per borrower. The degree of overlap is impossible to determine.

Impact of delayed foreclosure. Gross uncollected interest is the amount of delinquent loan volume lenders could have collected multiplied by the average interest

Table 3. Economic Impact on Creditors from Delayed and Partial Repayment

	Volume Restructured	Frequency	Amount	Economic Impact
	<i>Million Dollars</i>			<i>Million Dollars</i>
<i>Impact from Delayed Repayment</i>				
Before Acquisition ^a				
Interest Accrued				22.8
Interest Paid				(.8)
Maintenance Costs				1.9
Loss on Collateral Value				— ^d
Total Impact Before Acquisition				23.9
After Acquisition ^b				
Loss of Income				43.0
Rentals Received				(18.1)
Maintenance Costs				3.9
Loss on Collateral Value				33.4
Total Impact After Acquisition				62.2
<i>Negotiated Settlements^c</i>				
Restructured for Ongoing Operation				
Principal Written Off	—	14.71%	4.03%	1.0
Accrued Interest Written Off		23.50	18.12	.4
Interest Reduction (Basis Pts.)		30.81	300	12.1
Additional Collateral		65.70	—	— ^d
Total	162.1			13.5
Settled for Termination or Workout of Operation				
Principal Written Off		59.48%	23.42%	25.0
Accrued Interest Written Off		59.20	70.92	4.1
Interest Reduction (Basis Pts.)		38.03	325	17.9
Additional Collateral		14.97	—	— ^d
Total	179.6			47.0
<i>Impact from partial repayment</i>				
Antideficiency Judgment				25.7
<i>Total Economic Impact of Partial and Delayed Repayment</i>				172.2

^aAverage loan delinquency is six months.^bRetained ownership for fourteen months.^cBased on settlements negotiated between January 1, 1985, and July 1, 1986.^dInconclusive data.

rate on the debt and the duration of the delay. The amount collectible was defined in a previous section to be the lesser of (a) the outstanding delinquent principal and (b) the proceeds from sale of the collateral adjusted for amounts exempt from legal process. Collectible principal for each of the 2,086 delinquent loans was estimated from information obtained in survey 1 as to the likely proceeds from sale of securing

property, unencumbered assets, and exemptions. Those amounts were adjusted for missing values, summed, and expanded to the state level. Lenders could realistically collect \$423.5 million of the \$466.1 million loan volume delinquent on July 1, 1986.

An average interest rate on delinquent debt of 9.94 percent was estimated by dividing interest paid on farm mortgage debt by the

amount of real estate debt outstanding for 1984, both of which are reported for North Dakota by USDA. An average interest rate of 10.45 percent was also estimated from lender's financial statements (requested by survey 2). However, commercial bank lenders categorized only 36.5 percent of their loan volume as agricultural, which may impact their average interest rate. Therefore, the latter rate is not considered.

The average length of time each loan was reported delinquent in survey 1 is .54 years. Multiplying the amount lenders could collect (\$423.5 million) by the average interest rate (9.94 percent) and the duration of delay (.54 years) yields gross uncollected interest of \$22.8 million. However, 3.1 percent of the borrowers continued to make \$.8 million in interest payments on their delinquent loans. Subtracting that amount from gross uncollected interest results in \$22 million of net uncollected interest.

Lenders are also impacted by maintenance costs and changes in collateral value from the time of default until the obligation is brought current or the collateral is acquired. Maintenance costs include insurance, property taxes, and repairs. In survey 1, lenders are asked to estimate annual maintenance costs for each delinquent loan before foreclosure. At the state level, annual maintenance costs on collateral are calculated to be \$3.5 million. Linearly adjusting the estimate to reflect the .54 years average delinquency reported as of July 1, 1986, results in maintenance costs of \$1.9 million dollars. Data to estimate the economic impact of changes in the value of the collateral are inconclusive.⁴

Impact of delayed liquidation. Loss of income also arises because lenders are not able to immediately liquidate collateral after it is acquired to satisfy indebtedness. Loss of income is estimated as the sale value of the property multiplied by the lender's interest rate on new loans and the length of time the

property is held. The procedure is similar to that described earlier for estimating the economic impact of delay before the creditor acquires the collateral. Lenders report holding chattel for two months and land for fourteen months after acquisition. Loss of income after acquisition is estimated at \$43 million.

The loss of income is reduced, however, to the extent the lender derives income, such as rent, from the property during the ownership period. Although 64 percent of the acquired collateral generated some income during the time the creditor owned it, the average amount of income received is equivalent to only 42 percent of one year's rental.⁵ That occurs because property is acquired by creditors throughout the year—some of which cannot be rented until the following year. Land that is not rented continues to tie up the lenders' capital in nonperforming assets. The lack of revenue from the nonperforming assets reduces lenders' income and forces them to increase income from other assets (that is, interest rates on loans to nondelinquent farm borrowers). Lenders are estimated to receive \$18.1 million in rental revenues during the period they own acquired collateral. The estimate assumes that land can be rented for the equivalent of interest on the collateral. The cost to lenders of acquiring property that cannot be rented is \$24.9 million (\$43 million - \$18.1 million).

Lenders, as owners of the acquired property, are responsible for maintaining and insuring the property as well as paying taxes. Maintenance costs after acquisition will accrue at the same rate as before, which is estimated to be \$3.5 million per year. Adjusting the amount to reflect the average time creditors own acquired property results in an estimated maintenance cost of \$3.9 million.

During the time creditors hold the property, there is potential for either appreciation or depreciation of the collateral's value. Responses to survey 2 suggest collateral held

⁴There are a number of reasons why the data are inconclusive. First, information as to the number of prior liens was not elicited. Second, survey responses to this question vary considerably. Although average responses could have been calculated, it was decided to label the estimate as inconclusive—particularly given the short length of time involved.

⁵Lenders reported receiving no rent on 36 percent of their acquired property, renting 36 percent of their property for less than an equivalent year's rent, and renting 28 percent of their property for more than a year's rent.

by lenders has, on average, decreased 7.1 percent annually while lenders owned it. Considering a collectible loan volume of \$423.5 million, the impact of declining market values is \$33.4 million during the approximately fourteen months lenders own the property.

Negotiated Settlements

Lenders may negotiate a settlement either for an ongoing operation or as part of terminating the operation to avoid the usual costs of foreclosure. The amount of delinquent debt restructured for ongoing operations in North Dakota between January 1, 1985, and July 1, 1986, is reported by lenders to be \$162.1 million. During the same eighteen-month period, lenders negotiated on \$179.6 million of delinquent debt for termination (Table 3). Analysis of settlements by institution (after first adjusting for differences in loan volume) show a positive correlation (.93) between size of the institution and the amount of loan volume negotiated. The level of negotiation could not be related to the profitability of the institution.

Terms of negotiated settlements for the period from January 1, 1985, to July 1, 1986, were also elicited. Average values shown are calculated by weighting each lenders' response by the amount of debt they have settled. Thus, the responses of lenders who negotiated larger delinquent loan volumes are counted more heavily.

The cost to lenders of writing off principal equals the volume of debt negotiated multiplied by the frequency with which principal is written off and by the amount of principal that is typically written off. Lenders wrote off principal in 14.7 percent of the settlements for ongoing operations and 59.5 percent of the settlements for terminating operations. The amount written off is 4.03 percent for ongoing operations and 23.42 percent for terminating operations. The cost to lenders of principal written off through negotiated settlements approximates \$1 million for ongoing operations and \$25 million for terminating farm businesses.

Accrued interest is also written off by lenders 23.5 and 59.2 percent of the time for ongoing and terminating operations, respectively.

Lenders provided data in survey 1 that enables estimation of the amount of outstanding accrued interest. Interest on loan volume secured with real estate is, on average, .55 years delinquent and for chattel, .43 years delinquent. Again the average estimates were weighted according to the magnitude of the delinquent loan. The interest rate applied to the loan volume is the average rate charged on all outstanding real estate debt reported by USDA.

The cost to lenders of writing off accrued interest is calculated by multiplying the level of debt that was settled through negotiation by the average interest rate, the average length of delay weighted by the various types of property, the frequency with which accrued interest was written off, and the portion of accrued interest written off. The cost to lenders of writing off accrued interest is \$.4 and \$.41 million for ongoing and terminating settlements, respectively.

The final cost of negotiated settlements relates to interest rate reductions on the remainder of the loan's life. The cost equals the present value of the difference between the original rate and the negotiated rate. Lenders expect to offer 11.1 percent and 9 percent interest on chattel and real estate loans, respectively, in 1987. Lenders, on average, reduced interest rates on restructured debt by 300 and 325 basis points for ongoing and terminating operations, respectively. For the analysis, it is assumed repayment periods for chattel and real estate loans in North Dakota are five and thirty years, respectively. Further, it is assumed that delinquent borrowers are halfway through their repayment schedule. Thus, the present value of annuity factor used to capitalize the conceded interest is based on two and one-half and fifteen years depending on the type of property securing the loan. For ongoing operations, lenders conceded \$12.1 million of interest on the outstanding loan balance and \$17.9 million for terminating operations.

Borrowers provided additional collateral as part of 65.7 percent of the negotiated settlements for ongoing operations. Additional collateral was provided in less than 15 percent of the settlements for terminating operations. Creditors benefit from the additional collateral because their level of security has been increased. The survey

data are inconclusive, however, as to the dollar impact of the added security.

Impact of Partial Repayment

The antideficiency law primarily impacts undersecured mortgage holders. Estimation of the economic impact involves several steps to avoid double counting. First, the value of the collectible deficiency is calculated for each undersecured delinquent loan. Second, the impact of a law that permits partial repayment is identified as the lesser of (a) the collectible deficiency or (b) the amount of the debt. Third, summing the impact for all undersecured delinquent loans, the total economic impact of the law at the state level is estimated to be \$25.7 million (Table 3).

Economic Impact on Nondelinquent Borrowers

The survey elicited information on all delinquent loans as of July 1, 1986, and negotiated settlements since January 1, 1985. Even after the data have been annualized to adjust for differing time periods, it is difficult to estimate the magnitude lenders have to increase interest rates to their nondelinquent borrowers. The complication arises in part because the total economic impact consists of both a delayed collection of interest on which borrowers have defaulted and partial repayment of principal (loss of lenders' assets). The first impact affects the profitability of lenders in only one period whereas the second affects the profitability of lenders over more than a single period.

The loan pricing model developed in a previous section only evaluates single period delays arising from loan defaults. The model assumes lenders ultimately collect the original loan principal and only incur costs associated with collection delays. Using the data from lenders' financial statements and a 13.5 percent default rate, interest rates to nondelinquent North Dakota farm borrowers are calculated to be 146 basis points above the rate lenders could offer if they did not have loan defaults.

The full impact on interest rates to nondelinquent borrowers can be approximated by dividing the total costs of both partial and delayed repayment by the level of outstanding agricultural loan volume

in North Dakota.⁶ Using that method, it is estimated that lending rates to farm borrowers were 500 basis points above normal if all of the additional costs associated with partial and delayed repayment of delinquent loans were passed on during the period they are incurred. However, lenders more than likely increased rates (or failed to lower rates) once indications of problem loans surfaced. Lenders may also capitalize their losses. Nevertheless, this simplistic evaluation is deficient because the administrative costs associated with partial repayment are not accounted for.

Analysis of lenders' financial statements indicates they were absorbing some of the economic costs associated with delinquent loans. Combined revenues reported in their last financial statements are \$538 million while expenses totaled \$644 million, leaving a net loss of \$106 million.

Higher interest rates to farm borrowers is only one consequence of delayed or partial repayment. The other consequence is in the form of lower capital availability when lenders either ration credit or curtail lending activities. That action occurs because lenders can only raise interest rates so far before they begin to lose market share, attract riskier customers (adverse selection), and indirectly alter the behavior of existing customers who are forced to adopt riskier investments.

Higher interest rates may attract customers with riskier portfolios because those customers perceive the lender as projecting a low probability of repayment. In other words, customers borrow at high interest rates because they expect to default. Likewise, borrowers, who have sound intentions of repaying, are induced to undertake riskier investments or methods of production with lower probabilities of success but higher payoffs when successful in order to pay

⁶Alternately, lenders could pass losses on to all customers in addition to those agriculturally related. In doing so, though, lenders may lose market share in that area if customers are rate sensitive. In the long run, lenders to the agricultural sector must generate sufficient revenue to cover all costs associated with extending credit to the sector.

higher prices for credit and maintain their level of income and standard of living. As the variability of borrowers' income increases, lenders' portfolios are also placed in increased jeopardy.

Data to quantitatively estimate those relationships were not elicited in the survey, but theory suggests that increased delinquencies affect the behavior of both existing and new farm borrowers in a manner that reduces the overall availability of capital. Those findings are consistent with Alston who estimated that new farm mortgages issued by private lenders declined by 30 percent nationwide after the Great Depression (1932-34).

Conclusion

To fully understand the farm financial crisis — of the 1980s, economists and policy makers must be informed of its effects on both creditors and nondelinquent borrowers. Financial markets cannot operate efficiently if contractual arrangements are uncertain. The economic impact associated with statutory laws that permit delayed or partial repayment of delinquent agricultural loans is shown to be considerable. As of July 1, 1986, 13.5 percent, or \$466 million, of North Dakota's agricultural debt was delinquent. That is in addition to the \$342 million of debt already restructured for either ongoing or terminating operations. The cost to creditors in terms of lost income and collateral, additional maintenance costs, and adverse changes in market values is \$172.2 million.

References

Alston, Lee, J. "Farm Foreclosure Moratorium Legislation: A Lesson From the Past." *Amer. Econ. Rev.* 74(1984):445-57.

Lee, W.F., and C.B. Baker. "Agricultural Risks and Lender Behavior." In *Risk Management in Agriculture*, edited by P. J. Barry. Ames: Iowa State University Press, 1984.

North Dakota Century Code.

Stiglitz, Joseph, and Andrew Weiss. "Credit Rationing with Imperfect Information." *Amer. Econ. Rev.* 71(1981):393-410.

U.S. Department of Agriculture, Economic Research Service. *Economic Indicators of the Farm Sector—State Financial Summary, 1984*. ECIFS 4-5, Washington D.C., 1986.

Financial Health of U.S. Farm Businesses in 1984: A Region, Type, and Size Analysis

Allan E. Lines and Mitchell Morehart

Abstract

Liquidity, solvency, and profitability indicators are used to develop a multidimensional ordinal measure of farm business financial health. Weighted ordinal logistic regression is employed to examine farm business financial health relative to region, type, and size of farm. Findings suggest the "farm crisis" in 1984 was more severe from a farm business perspective than previously reported.

Key words: farm, financial region, type, size.

The U.S. farm sector has experienced a period of substantive economic decline over the past five years. Farm real estate values, a reflection of farm business economic health, peaked in 1981 and have declined each year since. Farm debt, after a decade of rapid increase, has leveled off and has only recently begun to decrease. The increasing number and amount of farm loans being liquidated or in a delinquent state during the period evidence the growing degree of financial ill-health on U.S. farms (Wilkinson).

Numerous studies have enhanced the understanding of the "farm crisis" from state, regional, and national perspectives (USDA 1985a; Lines and Zulauf; Dobson, et al.; Lines and Pelly; Food and Agricultural Policy Research Institute). They examine the immediacy of farm family financial stress using debt-to-asset ratios or cash balances for indicators. Focusing attention on the near-term cash crisis that farm families have been experiencing, the studies appropriately incorporate cash generating and conservation strategies commonly employed by farm families. This study changes the focus to the intermediate and longer run by stressing profitability of the business.

The objective of this study is to improve understanding of the U.S. farm crisis from a business management perspective by (a) developing a comprehensive multi-dimensional indicator of farm business financial health and (b) rigorously analyzing cross-sectional data to determine the statistical association of region, farm type, and farm size with relative farm business financial health.

The paper is organized as follows: (a) development of the conceptual framework and the ordinal measure of farm business

Allan Lines is an associate professor in the Department of Agricultural Economics and Rural Sociology, The Ohio State University, and Mitchell Morehart is an agricultural economist with the Economic Research Service, U.S. Department of Agriculture. The authors are grateful for the reviewers' helpful comments that improved the presentation and content of this paper and for the cooperative and financial support provided by USDA under cooperative agreement no. 58-3523-5-00350.

Table 1. Farm Business Financial Health, Development of Ordinal Indicator

Level of Ordinal Indicator Y_i	Solvency ^a	Liquidity ^b	Profitability ^c
<i>Alternative Combinations of Measures</i>			
0 (best)	S	S	S
1	U	S	S
2	S	U	S
3	U	U	S
4	S	S	U
5	U	S	U
6	S	U	U
7 (worst)	U	U	U

^aAs measured by debt-to-asset ratio; satisfactory when debt-to-asset ratio is ≤ 5 , unsatisfactory when debt-to-asset ratio is > 5 .

^bAs measured by adjusted cash balance; satisfactory when adjusted cash balance is ≥ 0 , unsatisfactory when adjusted cash balance is < 0 .

^cAs measured by rate of return to assets; satisfactory when rate of return to assets is ≥ 4 percent, unsatisfactory when rate of return to assets is < 4 percent.

financial health, (b) discussion of the data base and estimation methods, (c) presentation of the model used to estimate sample parameters, and (d) interpretation and summary of results.

Ordinal Measure of Financial Health

Assessment of financial health, from a business management perspective, includes some measure of (a) liquidity—the ability of the business to meet its short-term financial obligations, (b) solvency—a measure of risk-bearing ability, and (c) profitability—an indicator of longer-run survivability. Previous studies have not simultaneously considered those measures of financial viability. Long-run farm business financial health has not been captured by using cash balance or debt-to-asset ratios for the following reasons: (a) nonfarm earnings and unpaid family labor subsidized farm losses, (b) positive cash flows were created by allowing farm families to “live off of depreciation,” and (c) unaccounted-for changes in inventory temporarily disguised or created cash flow stress.

A multidimensional ordinal variable was developed to incorporate those elements into the assessment of farm business financial health. It is constructed (Table 1) using heuristic rules to establish criterion levels. Liquidity, solvency, and profitability, respectively, are assumed satisfactory if (a) the business could meet its short-run cash

needs (operating costs, operator labor charges, and principal payments), (b) debt-to-asset ratio does not exceed the point where lender and farmer are equally invested (.5), and (c) rate of return to assets is not less than the average long-term current return to farm assets (.04) (Melichar); otherwise they are unsatisfactory.

Profitability is the prime determinant of the ordinal ranking of farm business financial health. A favorable profit picture is viewed as most important because it indicates, *ceteris paribus*, an ability to correct unsatisfactory liquidity or solvency. Liquidity is the second criterion for ranking financial health. A business is perceived to be in a better financial state, *ceteris paribus*, if it does not have to borrow additional funds to meet cash obligations, regardless of profit condition, and thus commit itself to paying current expenses out of future income. Support for liquidity as the second ranking criterion is evident by noticing that an unfavorable solvency position for farms displaying favorable profit and liquidity does not create liquidity problems (that is, profits are great enough to service higher debt-to-asset ratios and yet maintain favorable cash balances).

Data Base and Estimation Methods

The source of data is the 1984 *Farm Costs and Returns Survey* (FCRS). The survey, a joint effort of the Statistical Reporting Service and the Economic Research Service, U.S. Department of Agriculture (USDA), consists

of 23,286 personal interviews by 1,600 trained enumerators that yielded 13,003 usable questionnaires. The data collected on farm expenditures, income, capital investments, inventories, and financial information relative to demographic and other farm characteristics has been used extensively in other financial analyses of the farm sector (USDA 1985a; Melichar 1985). A multiframe, stratified sample consisting of list and area frames was surveyed. Farms from the list frame are stratified by various criteria such as economic size and size of labor force; the area frame is stratified by land use type. The sampling scheme allows for the construction of survey expansion factors that are equal to the inverse of the selection probability. The expanded number of farms covered by the FCRS totals 1.7 million, compared with 2.2 million farms from the 1982 Census of Agriculture. The census included .3 million farms with sales of less than \$1,000 that are excluded from the FCRS. Most undercounting of farms was for small sales classes. The survey provides a representative count for commercial farms (USDA 1985a).

Data properties, in particular the ordinal nature of the dependent variable, limit the candidates for estimation technique to models of qualitative choice. Alternative specifications within that class of models include the linear probability model, the linear discriminant model, the probit model, and the logit model.

Empirical applications of the linear probability model have been discouraged based on problems that arise when conventional linear regression principles are imposed on a specification that includes a noncontinuous dependent variable (Pindyck and Rubinfeld; Judge, et al.). The linear discriminant model has received considerable use in analyses of qualitative choice. It has been shown, however, that presence of discrete exogenous variables within the model violates the basic assumption of multivariate normality (Halperin, et al.; Press and Wilson; Harrell and Lee; Efron). As a consequence, significance tests regarding coefficients of the linear discriminant model may yield misleading conclusions.

The probit and logit formulations are monotonic transformations that insure that

predicted values of the dependent variable are confined to its range. The probit model is based on the standard normal density function, while the logit model relies on the logistic density function. It is often argued that the logit model has computational advantages because it is a closed functional form with convenient curvature properties for numerical optimization. The probit model, on the other hand, has as its argument the limit of an integral that cannot be expressed in closed form. The justification for the choice of the logit model over the probit model is tenuous for binary dependent variable applications, because with maximum likelihood estimation (as occurs in most applications) computational difficulties are virtually indistinguishable regardless of standard distribution function selected (Capps). Applications of both models may be found in recent agricultural economics studies of qualitative choice (Chambers and Foster, probit; Garcia, et al. and Lines and Zulauf, logit; and Capps and Kramer, logit and probit). Empirically, the choice between probit and logit is based on convenience, especially with respect to available computer software. In this study the logit model is applied because available software easily handled the complexities of estimation given the eight-class ordinal variable and the availability of survey weights.

Econometric Model

LOGIST, an SAS procedure, was used to estimate the probability of a business being in financial health category j or above (Harrell 1983 and 1985). Because of the biased nature of the sample, a weighted LOGIST procedure was used (DuMouchel, et al.). The weights in this case correspond to the survey expansion factors described above. The weighted ordinal logistic model for the dependent variable having values $0, 1, \dots, 7$, can be stated as follows for $1 \leq j \leq 7$

$$\text{Probability } (Y_i \geq j) = 1 / e^{-(\alpha_j + \beta_1 X_{i1} W_i + \dots + \beta_m X_{im} W_i)}$$

Parameters are estimated using the following log linear transformation

$$\text{logit Probability } (Y_i \geq j) = \alpha_j + \beta_1 X_{i1} W_i + \dots + \beta_m X_{im} W_i -$$

where

Y_i = ordinal indicator for i th observation,

j = value of ordinal indicator,
 α = intercept term,
 X_i = predictors for i th observation,
 β = regression coefficients,
 W_i = weight variable for i th observation.

A separate parameter α_j is required for each level of $Y_i = 1, 2, \dots, 7$, and Probability ($Y_i = 0$) is obtained from 1-Probability ($Y_i \geq 1$). The model uses the ordering of Y s, but no assumptions are made regarding the spacing of scale intervals. Other model assumptions include independence of the X s and linearity in each X (Harrel and Lee). The independent variables include (a) a dummy variable for each of ten U.S. agricultural regions, as defined by the Statistical Reporting Service; (b) a dummy variable for each of ten farm types, as defined by Standard Industrial Code classifications; (c) a dummy variable for type of business organization (proprietorship or not); (d) a dummy variable for degree of enterprise specialization; (e) log of gross income (a measure of size); and (f) percent of land operated that is rented.

Corn Belt, Lake State, and Northern Plains farms and cash grain, livestock, and dairy farms were hypothesized to have a higher probability of being in poor financial health (USDA 1985b)—cash grain due to declining crop prices and increasing land debt and livestock and dairy due to their high ratio of depreciable assets to total assets. Large farms were expected to be in better financial health than smaller farms (USDA 1985b) as were businesses that rented a higher proportion of the operated acreage (Lines and Zulauf). Specialized farms and

proprietorships were anticipated to be in better financial health due to their ability to spread overhead costs and their potential for closer cost control and better management, respectively.

Results

The relative incidence of financial health categories with respect to farm size, type, and region are provided in Tables 2 to 4. The distributions have a bimodal character. Farm businesses, for the most part, exhibit either good or poor financial health. The reader is reminded that this analysis excludes off-farm earnings but includes estimated inventory changes, depreciation allowances, and charges for family labor.

The financial health of commercial farms is better than for all farms, and that of larger commercial farms is better than smaller commercial farms (Table 2). Restricting the analysis to commercial farms (at least \$40,000 gross income) changes the distribution of financial health, relative to all farms. Nearly 70 percent of all farms have poor financial health (categories 6 and 7). Only 40 percent of commercial farms are so classified; approximately 40 percent of commercial farms and only 20 percent of all farms are in good financial health (categories 0 and 1). Restricting size to a minimum of \$100,000, then \$250,000, further shifts the distribution away from poor financial health categories toward good. Approximately 55 percent of the largest commercial farms (at least \$250,000 gross income) are in good financial health; one-

Table 2. Farm Business Financial Health: Size Comparison, U.S. Farms, January 1985

Financial Health Category	All Farms	Gross Income At Least		
		\$40,000	\$100,000	\$250,000
		Percent of Farms ^a		
0 (best)	15	31	35	42
1	4	7	10	13
2	1	3	4	5
3	2	4	5	6
4	10	14	10	6
5	*	*	*	*
6	59	29	25	19
7 (worst)	9	11	11	9

*Less than 1 percent.

^aPercentages may not add to 100 due to rounding.

Table 3. Farm Business Financial Health: Regional Comparison, U.S. Farms, January 1985

Financial Health Category	All Farms			Commercial Farms ^a		
	Corn Belt	Northeast	N. Plains	Corn Belt	Northeast	N. Plains
	<i>Percent of Farms^b</i>					
0 (best)	20	10	27	33	31	35
1	7	1	6	14	2	8
2	2	*	2	3	*	2
3	3	1	3	6	1	6
4	10	8	11	10	10	13
5	*	*	*	1	*	*
6	49	71	40	23	47	23
7 (worst)	11	8	11	10	8	13

*Less than 1 percent.

^aAt least \$40,000 gross income.^bPercentages may not add to 100 due to rounding.**Table 4. Farm Business Financial Health: Farm Type Comparisons, U.S. Farms, January 1985**

Financial Health Category	All Farms			Commercial Farms ^a		
	Grain	Livestock	Nursery	Grain	Livestock	Nursery
	<i>Percent of Farms^b</i>					
0 (best)	27	8	13	40	24	44
1	7	2	2	9	5	20
2	2	1	*	3	3	*
3	4	1	*	5	5	*
4	11	8	5	11	11	6
5	*	*	*	*	*	*
6	41	72	70	24	40	18
7 (worst)	9	9	11	9	12	12

*Less than 1 percent.

^aAt least \$40,000 gross income.^bPercentages may not add to 100 due to rounding.

fourth remain in poor condition. The results suggest a strong continuum of improved financial health associated with farm size.

Tables 3 and 4 clearly demonstrate (a) regional and farm type differences in farm business financial health and (b) that commercial farms have better financial health, irrespective of region or type of farm. On an all farms basis, farm business financial health worsens as the region changes from Northern Plains to Corn Belt to Northeast. That result is probably due to the larger relative number of farms in the Northeast with sales less than \$40,000. In particular, farms with sales less than \$40,000 and with no off-farm income appear to be in poor business financial health. There is little apparent difference between Corn Belt and Northern Plains commercial farms; but all

Northeast farms remain in worse financial condition. In 1984, commercial farms had better financial health than all farms, regardless of region. On an all farms basis, livestock and nursery-greenhouse farms are in worse financial health than grain farms. When only commercial farms are considered, nursery-greenhouse farms are in better financial health than either grain or livestock farms; livestock farms remain in the worst financial condition. Regardless of type, commercial farms exhibited better financial health than do all farms.

The estimated changes in probability and beta coefficients in Table 5 must be interpreted with care. The ordinal character and definition of the dependent variable (odds of being classified in category *j* or higher) require variable specification as the

Table 4. Estimated Changes in Log Probabilities: Financial Health Categories, U.S. Farms, January 1985

Variable	All Farms			Commercial Farms		
	Change in Probability of Being in Category $\geq 6^a$	Beta Coefficient	Chi-Square Statistic	Change in Probability of Being in Category $\geq 6^a$	Beta Coefficient	Chi-Square Statistic
<i>Region^b</i>						
Northeast	.08*	.39*	10.8	.10*	.39*	8.8
Lake States	.12*	.57*	36.2	.03	.14	1.8
Northern Plains	.03	.14	2.2	-.02	-.06	.4
Appalachia	.01	.06	.4	-.06	-.24	3.1
Southeast	.03	.15	1.4	.05	.19	1.4
Delta States	.04	.18	2.1	.03	.14	.7
Southern Plains	.06*	.27*	7.9	.04	.17	1.6
Mountain	.14*	.67*	29.2	.11*	.45*	13.1
Pacific	.10*	.49*	13.1	.14*	.55*	10.7
<i>Type of Farm^c</i>						
Field Crops	.03	.16	2.1	-.02	-.09	.4
Vegetable/Melon	.04	.19	1.0	-.01	-.03	.0
Fruit/Tree Nut	.04	.17	1.0	.04	.14	.3
Nursery/						
Greenhouse	.04	.18	.9	-.31*	-1.26*	19.7
General Crop	.04	.18	2.1	.06	.26	2.6
General						
Livestock	.13*	.60*	71.0	.15*	.61*	52.9
Dairy	.16*	.75*	58.9	.16*	.65*	47.5
Poultry/Egg	.02	.11	.3	-.11	-.46	5.9
Other Livestock	.22*	1.05*	25.4	.37*	1.51*	17.7
<i>Ln (Gross Income)</i>	-.11*	-.53*	738.2	-.14	-.57*	162.0
<i>Percent of Land Rented</i>						
Rented	-.06*	-.29*	16.1	-.12	-.50	32.0
<i>Specialization</i>	-.06*	-.27*	23.7	-.01	-.14	4.9
<i>Business Type</i>	.05*	.25*	9.5	.02	.10	1.3
<i>Model Statistics</i>						
Chi-Square with 22 d.f.		1474			505	
p Value		.0000			.0000	
Rank Correlation Index		.71			.63	

*Significant at $\alpha = .01$.^aCalculated at sample means for each level of ordinal constant.^bOmitted region, Corn Belt.^cOmitted type, Grain.

point of reference for expressing changes in probability. In Table 5 this is the probability of being in category 6 or greater. The nature of the independent variable (continuous versus binary) also influences the interpretation of the change in probability. For continuous variables, the usual elasticity interpretation holds. For binary variables, however, the change in probability is relative to the omitted category. The changes in probability are interpreted as follows: (a) a commercial farm in the Northeast (a binary variable) has a 10-percent greater chance of being in category 6 or greater (reference

point) than does a commercial farm in the Corn Belt (omitted category), (b) increasing the percentage of land rented (a continuous variable) by 1 percent reduces the probability of a commercial farm being in category 6 or greater by 12 percent. The left side of the logistic model is a logarithm of the odds of being classified in category j or higher. Since a logarithm is a monotonic transformation, the log odds reveal characteristics of the underlying probability (Pindyck and Rubinfeld). Beta coefficients of dummy variables (region, type, specialization, and business type) act as

intercept shifters of the log probability functions of a farm being in category j or greater; negative significant coefficients imply improved financial health and positive coefficients imply the opposite, relative to farms in the omitted class. Coefficients of continuous variables (gross income and percent of land rented) act as slope indicators of the log probability functions. Negative significant coefficients imply improved financial health as the independent variable increases; positive coefficients imply the opposite. Magnitude differences of significant coefficients indicate differential intercept shifts and slopes and infer a greater or lesser change in financial health.

In the context of all farms, farms located in the Northeast, Lake States, Southern Plains, Mountain, and Pacific regions exhibited significantly worse financial health during 1984 (a higher probability of being in category j or greater) than farms in the Corn Belt. ($\alpha = .01$). The financial health of farms in the remaining regions is not significantly different from that of Corn Belt farms. No region, when considering all farms, has significantly better farm business financial health than the Corn Belt (that is, farms in the Corn Belt are not worse off than other regions). In the context of commercial farms, the Lake States and Southern Plains regions are not significantly different from the Corn Belt region. In 1984, commercial farms in the Pacific region (coefficient .55) had a higher probability of being in category j or greater (worse financial health) than farms in the Northeast region (coefficient .39). The results do not support the hypothesis that farms in the Corn Belt, Lake States, and Northern Plains are in worse financial health than farms in other regions.

On an all farm basis, livestock, dairy, and other livestock farms have significantly worse financial health than do grain farms. When minimum size is restricted to \$40,000 gross income or more, the financial health of nursery-greenhouse farms is significantly better than grain farms. The results support the hypothesis that livestock and dairy farms are in worse financial condition. However, in 1984, grain farms were not found to be worse off than other types of farms, except as noted above.

The remaining dummy variables—specialization and business type—are

significant with the correct sign, in the context of all farms, but neither is significant when only commercial farms are considered. The significant coefficients (all farms) mean that farms with some, but not excessive, diversification and farms organized as proprietorships have better financial health compared with completely specialized or very diversified farms and those organized as nonproprietorships. The lack of significance on commercial farms is not surprising. Smaller (noncommercial) farms would be expected to exhibit a greater degree of diversification and a higher incidence of proprietorship organization. Removal of those farms (commercial farm analysis) results in a more homogeneous sample, compared with the variables, hence the disappearance of significance.

Coefficients for gross income and percent of land rented are significant and have the proper signs. The results support the hypothesis that larger farm businesses and those that rent a greater percentage of land operated are in better financial health. Those relationships, characterized by negative coefficients, are illustrated in Figures 1 and 2. Small farm businesses have a very high (low) probability of being in financial health category 6 or greater (1 or less). As farm size increases, the probability of being in financial health category 6 or greater diminishes from near 1 to .3; conversely, the probability of being in category 1 or less increases from near 0 to .5. Similar relationships exist for percent of land rented in all farms and commercial farms.

Figure 1. Financial Health vs. Gross Income, All U.S. Farms, January 1985

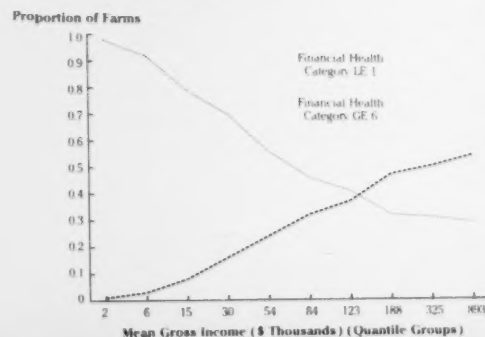
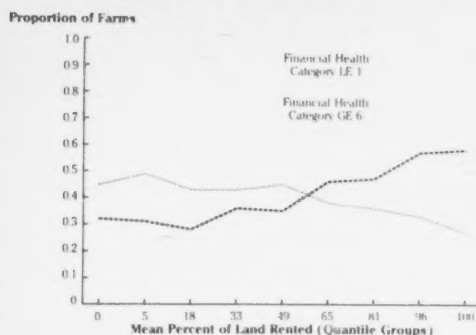


Figure-2. Financial Health vs. Percent Land Rented, Commercial U.S. Farms, January 1985



Model validity is substantiated by the likelihood ratio chi-squares of 1474 and 505. The predictive ability of the model is assessed by examining its rank correlation statistic, which has a range of 0 (no predictive ability) to 1 (perfect predictive ability). The statistics for the model are .71 and .63, not unreasonable for cross-sectional analysis.

Summary, Implications, and Limitations

The findings indicate that the farm crisis during 1984, when examined from a comprehensive view of business financial health, has potentially more severe long-run implications for farm business financial health. Using the same data and addressing the near-term cash crisis, USDA concludes that 12 percent of all farms are financially stressed (USDA 1985a). The Federal Reserve Board, using the same data, suggests that 17 percent of commercial farms are financially stressed (Melichar 1985). Nearly 70 percent of all U.S. farm businesses and 40 percent of commercial farms are in serious financial difficulty, when off-farm income, inventory changes, depreciation, and unpaid family labor are taken into account. This is not to say that the percentages will fail in the near or not too distant future. Some farm businesses will likely continue to be subsidized by off-farm income and unpaid family labor, and others will survive for some time by delaying the replacement of depreciable assets.

In 1984, financial health was poorest on dairy and livestock farms. Grain farms and farms in the Corn Belt or Northern Plains regions are not worse off than most others. Of commercial farms, nursery-greenhouse farms are significantly better. Increased farm size and a higher portion of land rented significantly increase the probability of having good financial health. Limiting diversification and being organized as a proprietorship are positively associated with financial health only on an all farms basis; neither variable is significant on commercial farms.

The results have important implications for agricultural policy. In 1984 poor farm business financial health was pervasive in U.S. agriculture and was worse in some regions, on some types of farms, and on smaller farms. Tightly targeted economic assistance will address only part of the problem and will result in proliferation of costly specific programs that may reward poor or part-time managers who may not warrant, need, or desire assistance. A broad spectrum approach designed to shift the distribution upwards in Tables 2 through 4 will likely have high unacceptable public cost, encourage overinvestment in agriculture, and result in overproduction and low incomes. Operators of farm businesses subsidized by off-farm income, by unpaid family labor, or by asset depletion may benefit from policies designed to help them understand broad economic issues and problems and adjust to economic realities. Likewise, policies that encourage development and implementation of, as well as farmers' participation in, educational and assistance programs that emphasize understanding, attainment, and maintenance of good farm business financial health may be beneficial.

Much of the financial ill health identified in this analysis results from exclusion of off-farm income and inclusion of estimated depreciation. Both are important from a policy perspective. Policies grounded in the concept that the economic well-being of farm businesses includes off-farm income foster a farm sector dominated by part-time and commercial farms that are subsidized by family members working outside the sector. Farm families themselves, rather than the general public, absorb the hidden costs of

ensuring an adequate food supply. In addition, policies dependent upon a definition and a measurement of farm financial stress that exclude depreciation likely underestimate the severity of the crisis, exacerbate the transition to part-time farms, and jeopardize sector productivity. Despite the lack of observed data, it is quite likely that many farm businesses, during the past five years, have avoided being classified as financially stressed by not replacing depreciable assets consumed in production. If current conditions persist, many commercial operators will likely exhaust their ability to live off depreciation and find themselves unable to continue in business. Policies designed to address the farm financial crisis without considering those components of the problem may be short-sighted and unable to deal with continued economic deterioration in the farm sector.

The weighted ordinal logistic regression methodology and model used in this study provide a powerful analytical tool for researchers and policy analysts concerned about the financial well-being of the U.S. farm sector. By using the model it is possible to predict, with 70 percent accuracy, the probability of a farm having good, fair, or poor financial health, given a distinct set of exogenous variables. However, several limitations likely affect results and model performance. Observed data precludes the inclusion of exogenous variables such as timing, type, quantity, and financing of recent capital purchases and operator age, education, and management ability—all thought to be important predictors of farm business financial health. Data limitations also necessitate several assumptions and imputations (for example, depreciation) to obtain a measure of profitability. Hence, a critical dimension of the dependent variable is not expressly observed data. In addition, the dependent variable is created using heuristic criteria and ordering rules. Among other useful issues to be investigated, this study did not, because of data limitations, examine how well the model "correctly" classifies the dependent variable conditional on various independent variables.

Further improvement of the data base (that is, direct observation of components of profitability) and continued development of the model likely will improve model

performance and provide fertile ground for future research. The model provides a mechanism for synthesizing global or restricted sensitivity analyses with respect to (a) assumptions in the model, (b) satisfactory and unsatisfactory criteria levels for variables used to assess farm business financial health, (c) alternative formulations for, or observance of, the dependent variable, and (d) the impact of policy variables in an attempt to determine how each would affect the distribution of farms in alternative states of financial health. Continued use of this econometric technique will permit the investigation of a critical policy question: "Is the current farm financial situation a temporary crisis or a new norm?" The answer will play a vital role in determining the development of future policy objectives and programs.

References

- Capps, Oral, Jr., and Randall A. Kramer. "Analysis of Food Stamp Participation Using Qualitative Choice Models." *Amer. J. of Agr. Econ.* 67(1985):49-59.
- Chambers, Robert G., and William E. Foster. "Participation in the Farmer-Owned Reserve Program: A Discrete Choice Model." *Amer. J. of Agr. Econ.* 65(1983):120-24.
- Dobson, W.D., et al. "Results of Indiana Farm Finance Survey." *Purdue Agricultural Economics Report*, July 1985.
- DuMouchel, William H., and Greg J. Duncan. "Using Sample Survey Weights in Multiple Regression Analyses of Stratified Samples." *J. of the Amer. Stat. Association* 78(1983):535-43.
- Efron, Bradley, "The Efficiency of Logistic Regression Compared to Normal Discriminant Analysis," *J. of the Amer. Stat. Association* 70(1975):892-98.
- Fletcher, Stanley M., Dale H. Catley, and Joseph V. Terza. "Analysis of Factors Affecting the Economic Viability of Dairy Farmers Using a Multiorordered Response Model." Selected paper presented at the American Agricultural Economics Association meeting, Ames, Iowa, August 1985.
- Food and Agricultural Policy Research Institute. *Summary Report: Economy-Wide Impacts of the Farm Financial Crisis*. Staff report no. 9-85, rev., July 1985.

Garcia, Philip, Steven T. Sonka, and Michael A. Mazzaco. "A Multivariate Logit Analysis of Farmers' Use of Financial Information." *Amer. J. of Agr. Econ.* 65(1983):136-41.

Halperin, Max, William C. Blackwelder, and Joel I. Verter. "Estimation of the Multivariate Logistic Risk Function: A Comparison of the Discriminant Function and Maximum Likelihood Function Approaches." *J. of Chronic Diseases* 24(1971):125-58.

Harrell, Frank E., Jr. "The LOGIST Procedure." In *SUGI Supplemental Library Users Guide*. Gary, NC: SAS Institute, Inc., 1983.

_____. "The LOGIST Procedure." In *Changes and Enhancements in the Version 5 SUGI Supplemental Library*. Technical report S-131. Gary, NC: SAS Institute, Inc., 1985.

Harrell, Frank E., Jr. and Kerry L. Lee. "The Practical Value of Logistic Regression." In *SAS Users Group International Conference Proceedings*. Gary, NC: SAS Institute, Inc., 1985.

Judge, G., W. Griffiths, R. Hill, and T. Lee. *The Theory and Practice of Econometrics*. New York: John Wiley and Sons, 1980.

Lines, Allan E., and Carl Zulauf. "Debt-to-Asset Ratios of Ohio Farmers: A Polytomous Multivariate Logistic Regression of Associated Factors." *Agr. Fin. Rev.* 45(1985):92-9.

Lines, Allan E., and Robert Pelly. "1985 Ohio Farm Finance Survey Results." ESO-1214. Department of Agricultural Economics and Rural Sociology, The Ohio State University, 1985.

Melichar, Emanuel. "Capital Gains Versus Current Income in the Farming Sector." *Amer. J. of Agr. Econ.* 61(1979):1085-92.

_____. "Farm Financial Experience and Agricultural Banking Experience." Statement before Subcommittee on Economic Stabilization of the Committee on Banking, Finance, and Urban Affairs, U.S. House of Representatives, October 23, 1985.

Pindyck, Robert, and Daniel L. Rubinfeld. *Econometric Models and Economic Forecasts*. 2nd ed. New York: McGraw-Hill, 1981.

Press, S. James, and Sandra Wilson. "Choosing Between Logistic Regression and Discriminant Analysis." *J. of Amer. Stat. Association* 73(1978):699-705.

U.S. Department of Agriculture, Economic Research Service. *Financial Characteristics of U.S. Farms, January 1985*. AIB 495, July 1985a.

_____. *Agricultural Outlook January-February 1986*. AO-116. December 1985b.

Wilkinson, Donald E. Statement before the Subcommittee on Conservation and Credit of the House Committee on Agriculture, October 30, 1985.

Measurement of Financial Stress in Agriculture

David A. Lins, Paul N. Ellinger, and Dale H. Lattz

Abstract

Classification of farms by degree of financial stress has been widely used to judge the severity of the "financial crisis" in agriculture. Single classification criterion, such as the debt-to-asset ratio, however, do not adequately reflect the financial position of farm firms. Multiple classification criteria have often used a cash-based measure of income along with the debt-to-asset ratio to measure financial stress. This study shows that cash-based measures of income can lead to serious classification errors when compared with accrual-based measurement of income.

Key words: farmers, financial, stress, income.

Financial stress in agriculture has generated a tremendous need for information by policy analysts and the general public. The desired information can often be boiled down to a few simple, but not easily answered, questions such as: How many farmers are in trouble, and how serious are their financial problems? However, commonly used measures of financial stress may not reveal the true financial position of farm firms, which could lead to distortions in the perceived severity of the problem and consequently to inappropriate policy responses. In addition, individual farmers may rely on inappropriate criteria to judge their own financial position.

Financial stress has many dimensions, and no single definition is likely to cover all forms of financial stress. However, it is generally agreed that financial stress is related to annual net income and net worth relative to the financial needs of the firm. A combination of low or negative net income and net worth jeopardizes the farm firm's ability to cover family living expenses, meet existing debt obligations, and maintain ownership or control of assets necessary to operate the business.

Financial stress also has a time dimension. For example, two firms may have identical current financial positions. However, if one firm has been experiencing a deteriorating financial condition while the other has improved over time, lenders will likely treat those firms quite differently.

Financial stress is not, however, the same as financial risk. Farm firms with high leverage are often judged as highly risky, but unless adverse financial conditions occur, the firm does not experience financial stress as defined above.

The objectives of this paper are to review the definitions and limitations of several

commonly used measures of farm financial stress. Then, using a sample of farm records from the Illinois Farm Business Farm Management Associations, alternative measures of financial stress are evaluated. While the time dimension is important, our data are not adequate to provide an evaluation of that nature.

Commonly Used Measures of Financial Stress and Their Limitations

Debt-to-asset ratio. A review of recent literature suggests that the debt-to-asset ratio (D/A) ratio is the most commonly used measure of financial stress. For example, a coordinated survey of nine midwestern states used the D/A ratio as the primary criterion to measure the extent and degree of farm financial stress. Survey results focused on the number and percentage of farmers with D/A ratios in various ranges. Often such studies are accompanied by subjective statements such as:

The debt-to-asset ratio is generally considered as a primary measure of whether a farm will have cash flow difficulties (Illinois Cooperative Crop Reporting Service).

The Economic Research Service of the U.S. Department of Agriculture (USDA) has also relied heavily on the D/A ratio as a measure of financial stress. For example, in two landmark publications, *Financial Characteristics of U.S. Farms, January 1985* and *Financial Characteristics of U.S. Farms, January 1986* the D/A ratio is used extensively in cross-tabulations by size and type of farm and by region of the country.

One of the inherent problems of the D/A ratio as a measure of financial stress is that it requires accurate and comprehensive estimates of both assets and liabilities. If assets or liabilities are significantly over- or understated then the resulting D/A ratio may also be quite inaccurate. A study by Lins and Klinefelter, for example, shows that balance sheets measured under USDA constructs would slightly understate the amount of farm operator's assets and dramatically understate the amount of liabilities. Consequently, the D/A ratio would tend to be understated.

The valuation of assets and liabilities may pose another problem with using the D/A ratio as broad-based measure of financial stress. Valuation at "cost" or "book value" may give a quite different D/A ratio than a "market value" approach. Often, survey forms do not specify which valuation method to use.

Another problem in using the D/A ratio as a measure of financial stress is that it reveals little about the income-generating potential of the farm firm. In farming operations where the return on assets exceeds the cost of debt capital, a relatively high leverage ratio does not signal financial stress. In some cases a high D/A ratio is indeed a reflection of poor incomes and falling asset values. In other cases a high D/A ratio signals an appropriate business decision to take advantage of a profitable operation. The D/A ratio alone does not allow one to distinguish between those operations. Recognizing that limitation, USDA and others have often used cross-classification schemes to measure financial stress.

Net Cash Flows or Net Cash Income. Net cash incomes or net cash flows have also been used extensively by USDA and others as a measure of financial stress. Figure 1 identifies the manner in which USDA computes net cash income and net cash flow. Although cash flow is a useful measure to determine the liquidity position of farm firms, it has limitations as a measure of financial stress. Textbooks in agricultural finance (Penson and Lins; Barry, Hopkin, and Baker; Lee, Boehlje, Nelson, and Murray) all suggest the importance of using accrual rather than cash measures of income to measure profitability of a business. At issue here is the degree to which measures of financial stress may be distorted by using cash- rather than accrual-based measures.

Farmers with very serious financial problems may be able to generate a positive cash flow through the liquidation of crop and livestock inventories. Yet their profitability, measured on an accrual basis, is negative. In contrast, financially sound farmers may decide to postpone the sale of crop and livestock inventories for tax purposes, thereby creating negative cash flows in the current year. The basic problem arises from the measurement of financial conditions on a cash rather than

Figure 1. Farm Operator Income and Cash Flow Statement

Crop and livestock sales	+ Other farm income (net CCC loan transactions, government payments, custom income, other farm wages, etc.)	= Gross cash income from farm operation
Gross cash income from farm operation	- Cash operating expenses before interest payment	= Net cash income before interest payments
Net cash income before interest payments	- Interest and expenses	= Net cash income after interest payments (<i>NCOI</i>)
Net cash income after interest payments (<i>NCOI</i>)	- Estimate of debt repayment	= Net cash income after subtracting debt payments
Net cash income after subtracting debt repayments	+ Nonfarm income	= Cash income available to farm household from all sources
Cash income available to farm household from all sources	- Estimated cash family living allowance	= Net cash income to the household after business and household expenses but before taxes, other accrued liabilities, and noncash adjustments (<i>NCIFL</i>)

Source: U.S. Department of Agriculture, Economic Research Service. *Financial Characteristics of U.S. Farms, January 1986*, p. 6.

accrual basis. Seger and Lins document the tremendous dichotomy that exists between the cash- and accrual-based incomes of farming operations. Their work shows an average discrepancy of more than 80 percent between cash and accrual income measures.

Another problem associated with the USDA use of cash flows or net cash income is the failure to include depreciation as an expense item. Inclusion of depreciation charges is essential if accurate measures of profitability are desired.

USDA economists should not be faulted for using cash measures when measuring financial stress because they generally do not now have the information necessary to do accrual-based accounting. However, the data set used in this analysis allows us to examine the degree of distortion created by using cash measures.

Data and Analysis

Data used in the subsequent analysis are taken from a subsample of 474 cash grain farms in Illinois that participate in the Farm Business Farm Management record keeping program. The subsample was chosen because of the detailed records kept by the

operators. Information available from the sample includes a complete balance sheet and an accrual-based net farm income statement for calendar year 1985.

The data set used appears unique in that it allows us to compare cash-based with accrual-based income numbers for the same farming operation. In addition, complete balance sheet data for those operations allows for a comparison of net farm incomes on a cash or accrual basis with balance sheet ratios like the D/A ratio.

The basic focus of our analysis is on the use of cash- versus accrual-based measures of farm profitability in the measurement of financial stress. To test the relationship between accrual net farm income and net cash farm income, we estimate the following equation.

$$\text{Accrual Net Farm Income} = 12,187.63 + .453 \text{ Net Cash Farm Income } R^2 = .3$$

Notice that only 30 percent of the variation in accrual net farm income is "explained" by the amount of net cash farm income. It suggests that net cash farm income is a weak proxy for true profitability of a farming operation.

Table 1. Regression Estimates Using Alternative Definitions of Farm Profitability¹

Dependent Variable	Constant	Independent Variable	R ²
(a) Net Cash Farm Income (No Depreciation)	= 41,811.6	D/A Ratio - 274.13 D/A (4.83)	R ² = .05
(b) Net Cash Farm Income (Depreciation Subtracted)	= 18,979.8	- 260.30 D/A (4.99)	R ² = .05
(c) Accrual Net Farm Income	= 31,962.8	- 146.13 D/A (3.10)	R ² = .02

¹Sample size is 474. Numbers in brackets are *t* values.

Debt-to-Asset Ratio as a Single Classification Criterion

The widespread use of the D/A ratio as a single measure to classify farms with financial stress is based in part on the belief that the ratio correlates negatively with the farm profitability or net cash flows generated by the farming operation. To examine the validity of that assumption, we use our sample to perform simple regression estimates of the relationship between D/A ratio and the amount of farm profitability. Farm profitability is measured in three different ways: (a) net cash farm income (NCFI) as defined by USDA, (b) net cash farm income adjusted for depreciation (NCFI-depreciation), and (c) accrual net farm income. Accrual-based net farm income adjusts for changes in inventory, accounts receivable, accounts payable, and other asset and liability accounts needed to reflect true profitability. Results are reported in Table 1.

The regression results confirm a negative and significant relationship between farm profitability and the D/A ratio. However, the *R*²s are relatively low suggesting that little of the variation in farm profitability is explained by the D/A ratio.

One of the reasons why the D/A ratio does not explain a high percent of the variation in farm profits is the substantial difference in profitability associated with different types of farm debt. A study by Lins and Neff shows that farming operations with low amounts of land debt (part-owners or full tenants) could support much higher D/A ratios than owner-operators with large amounts of land debt. Since the D/A ratio alone does not indicate tenure position or type of debt used, it can

not be expected to explain a large portion of the variation in the profitability of farm firms.

As suggested earlier, a higher D/A ratio may signal a greater degree of financial risk but not necessarily a greater degree of financial stress. Perhaps a more appropriate measure would be the amount of wealth or net worth. If one can measure the D/A ratio one can also measure wealth. However, the D/A ratio is a weak indicator of the amount of wealth. A simple regression estimate of the amount of wealth as a function of the D/A ratio is given below.

$$\text{Dollar Amount of Wealth} = 624,244 - 6,124.8 \text{ D/A} \quad R^2 = .25$$

The results for our sample indicate that only 25 percent of the variation in the dollar amount of wealth is explained by the D/A ratio.

Multiple Classification Criteria

Recognizing the limitations of a single classification criterion, USDA and others have moved to a multiple classification approach to grouping farms by degree of financial stress. Figure 2 identifies multiple classification criteria suggested by USDA. It suggests that financial stress can be measured by the D/A ratio and the level of earnings.

Figure 3 identifies multiple classification criteria suggested by Melichar. The rationale of his classification criteria is that the degree of financial stress can be evaluated by four indicators: return on assets, return on equity, level of equity, and the D/A ratio. Returns on

Figure 2. Joint Distribution of Farms by Earnings and Solvency Class

Solvency	No debt or very low debt relative to assets	Moderate debt/asset position	High debt/asset or insolvent positions
Earnings			
Negative Earnings	<i>Class I</i> debt/asset ratios less than .1	<i>Class II</i> debt/asset ratios .1 to .4	<i>Class III</i> debt/asset ratios greater than .4
Positive Earnings	<i>Class IV</i> debt/asset ratios less than .1	<i>Class V</i> debt/asset ratios .1 to .4	<i>Class VI</i> debt/asset ratios greater than .4

Source: U.S. Department of Agriculture, U.S. Economic Research Service. *Financial Characteristics of U.S. Farms, January 1986*, p. 7.

Figure 3. Criteria for Classification of Commercial Farm Operators by Financial Position^a

If Debt/Asset Ratio Is	And if Return on Assets Is	And if Return on Equity Is	Then Financial Position Is
<i>Operators with Equity Under \$50,000</i>			
Under 40	Above 0	na	Good
40 to 70	Above 5	na	Good
Over 70	Above 15	na	Good
Under 40	-5 to 0	na	Fair
40 to 70	0 to 5	na	Fair
Over 70	5 to 15	na	Fair
Under 40	-15 to -5	na	Stressed
40 to 70	-5 to 0	na	Stressed
Over 70	0 to 5	na	Stressed
Under 40	Under -15	na	Vulnerable
40 to 70	Under -5	na	Vulnerable
Over 70	Under 0	na	Vulnerable
<i>Operators with Equity Above \$50,000</i>			
Under 40	Above 0	Above 0	Good
40 to 70	Above 5	Above 5	Good
Over 70	Above 15	Above 15	Good
<i>If Not Already Classified as Good, Then</i>			
Under 10	Above -15	Above -15	Fair
10 to 40	Above -5	Above -5	Fair
40 to 70	Above 0	Above 0	Fair
Over 70	Above 5	Above 5	Fair
<i>If Not Already Classified as Good or Fair, Then</i>			
Under 10	na	na	Stressed
10 to 40	Above -15	Above -15	Stressed
40 to 70	Above -5	Above -5	Stressed
Over 70	Above 0	Above 0	Stressed
<i>If Not Already Classified as Good, Fair, or Stressed, Then</i>			Vulnerable

na Not Applied.

^aFinancial position was determined by joint consideration of four indicators: Return on assets, return on equity, amount of equity, and debt-to-asset ratio. Return on assets is net cash operating income (before interest payments) as a percentage of owned assets. Equity is owned assets minus debt. Debt-to-asset ratio is debt as a percentage of owned assets.

Source: Melichar, Emanuel, "The Farm Credit Situation and Status of Agricultural Banks." Paper read at the Twin Cities Agricultural Issues Round Table, April 24, 1986.

Table 2. Classifications of a Sample of 474 Farms Based Upon USDA Criteria and Alternative Definitions of Farm Profitability

USDA Classification	Cash Income Using USDA Original Definition		Cash Income Adjusted for Depreciation		Accrual Income	
<i>Class I</i> Negative Income D/A < .1	4 ^a	.9%	9 ^a	1.9%	3 ^a	.6%
<i>Class II</i> – Negative Income D/A .1 to .4	12	2.5%	40	8.4%	15	3.2%
<i>Class III</i> Negative Income D/A > .4	44	9.3%	87	18.4%	40	8.4%
<i>Class IV</i> Positive Income D/A < .1	72	15.2%	67	14.1%	73	15.4%
<i>Class V</i> Positive Income D/A .1 to .4	179	37.8%	151	31.9%	176	37.2%
<i>Class VI</i> Positive Income D/A > .4	163	34.3%	120	25.3%	167	35.2%
<i>Total</i>	474	100%	474	100%	474	100%

^aNumber of farms in classification.

assets and equity, however, are calculated with cash- rather than accrual-based measures of income.

Table 2 shows how the 474 farms in our sample fit into the six classes proposed by USDA. Three different measures of farm profitability are used. The first measure is the original cash definition suggested by USDA, while the second is the USDA definition adjusted for depreciation expenses. The third definition is based upon accrual farm income concepts.

The results in Table 2 seem to suggest no major differences between the classification of farms based upon the original USDA definition of net cash farm income and the accrual-based measure of farm income. However, when net farm income with depreciation subtracted is used, a much higher number and percentage of respondents have negative net farm incomes.

Despite the relatively close agreement in the number of farms in each group between the original USDA definition of net cash farm income and accrual net farm income, there is cause for concern. The primary reason for

the small difference is that the exclusion of depreciation charges offset the generally positive accrual adjustment for inventory change. Had the accrual adjustments for inventory change been negative, dramatic differences in classification would likely have resulted.

Even though the total numbers of farmers in each category are relatively close no matter which definition of income is used, a significant number of individual farms would have ended up in different classes under the accrual definition. That is illustrated in Table 3. For farms with a D/A ratio of less than 10 percent, 7 to 10 percent of the farms would have been classified differently under the accrual income approach. For farms with a D/A ratio of more than 40 percent, 27 to 33 percent of the farms would have been classified differently under the accrual approach.

In summary, it appears that there is strong potential for classification of farms by financial stress category to differ when using a cash-based rather than an accrual-based definition of income. Because classification changes occur in both directions, the overall

Table 3. Classification Changes for USDA Criteria Based Upon Accrual Income

Nature of Changes in Classification	D/A Ratio		
	<10%	10-40%	>40%
<i>Cash Definition</i>			
Negative to Positive	4%	4%	15%
Positive to Negative	3%	6%	12%
Percent with Classification Change	7%	10%	27%
<i>Cash with Depreciation Subtracted</i>			
Negative to Positive	8%	17%	27%
Positive to Negative	2%	4%	6%
Percent with Classification Change	10%	21%	33%

percentage of farms placed in the various categories may not be dramatically different. The biggest problem may be if individual farmers rely on the suggested cash-based criterion to judge their own financial position.

Table 4 shows how the 474 farms in our sample fit into the four categories proposed by Melichar. Results pattern those reported in Table 2. Using the Melichar definition versus the accrual definition results in modest differences in the number of farms placed in each category. If Melichar's procedure were modified to include an adjustment for depreciation, then a much higher percent of farmers would have fallen into the stressed or vulnerable category.¹

Table 5 shows the percent of farms for which the classification would change as a result of

¹Discussions with Melichar revealed that the levels of return on assets and return on equity were selected at a somewhat higher level to compensate for the lack of depreciation estimates.

moving from a cash-based to an accrual-based method of classification. The results suggest very dramatic differences in classification, especially in the vulnerable and stressed categories. A more complete discussion of the vulnerable category follows.

Using Melichar's definition, thirty of the 474 farms would have fallen into the vulnerable category. By changing to an accrual-based measure of farm profitability, only nineteen of the 474 would have fallen into the vulnerable category. Although our sample cannot be generalized to the entire population, it does suggest that classification errors could be significant.

Perhaps the most interesting result of our comparison is that eighteen of the thirty farms classified as vulnerable by the Melichar approach were classified as good by an accrual-based approach. And only five of the thirty classified as vulnerable by the Melichar approach were classified as vulnerable by the accrual-based approach. Somewhat similar results occur for the farms classified as "stressed." If one accepts the premise that accrual-based measures of income are a better measure of financial well-being than cash-based measures, then errors in classification are likely to occur unless accrual-based estimates of income are employed. Individual firms need to use considerable caution in applying national classification criteria to their own situations.

Implications and Concluding Comments

This paper has focused on single and multiple classification criteria for measuring the degree and extent of farm financial stress. The lack of complete and accurate financial information has often hampered the

Table 4. Classification of a Sample of 474 Farms Based Upon Melichar's Criteria and Alternative Definitions of Farm Profitability

Melichar's Classification Criteria	Melichar's Original Definition		Cash Income Adjusted for Depreciation		Accrual Income	
Good	378*	79.8%	288*	60.8%	375*	79.1%
Fair	46	9.7%	83	17.5%	61	12.9%
Stressed	20	4.2%	37	7.8%	19	4%
Vulnerable	30	6.3%	66	13.9%	19	4%
Total	474	100%	474	100%	474	100%

*Number of farms in classification

Table 5. Classification of Financial Stress for Melichar's Cash Income Criteria Versus Accrual Income Criteria.

Classification	Melichar's	Accrual Classification			
	Classification	Good	Fair	Stressed	Vulnerable
<i>Cash Definition</i>					
Good	378	326	35	8	9
	100%	86.2%	9.3%	2.1%	2.4%
Fair	46	21	18	4	3
	100%	45.7%	39.1%	8.7%	6.5%
Stressed	20	10	4	4	2
	100%	50%	20%	20%	10%
Vulnerable	30	18	4	3	5
	100%	60%	13.3%	10%	16.7%
<i>Cash with Depreciation Subtracted</i>					
Good	288	265	16	4	3
	100%	92%	5.6%	1.4%	1%
Fair	83	59	21	1	2
	100%	71.1%	25.3%	1.2%	2.4%
Stressed	37	15	13	6	3
	100%	40.5%	35.1%	16.2%	8.1%
Vulnerable	66	36	11	8	11
	100%	54.5%	16.7%	12.1%	16.7%

classification process. For this study, a set of complete and verified data for 474 cash grain farms in Illinois is used to classify farms by financial stress using classification criteria suggested by USDA and Melichar.

The D/A ratio has been the most commonly used single classification criterion for measuring financial stress. The use of the D/A ratio has often been justified on the assumption that it reflects the incomes or cash flows of farming operations. Yet some highly leveraged farms have generated large profits and are not in financial stress, while other farms with low D/A ratios have lost money and may have relatively severe financial stress.

Regression estimates on our sample data suggest there is a negative and significant relationship between the D/A ratio and farm profitability, but the percent of variation in farm profitability that is explained is very small. The implication is that the D/A ratio is simply not a very reliable measure of financial stress in farming operations.

Multiple classification criteria for measuring financial stress have often relied on both the D/A ratio and a cash measure of income to

measure financial stress. However, cash income is a very poor indicator of the true profitability of a farming operation. Accrual-based measures of income are generally recognized as being a better measure of profitability, but data problems often prevent the measurement of accrual income.

In this paper, our sample data are classified according to criteria suggested by USDA and Melichar, but with both cash and accrual definitions of income. Results reveal modest differences in the number of farms classified into each category. However, this outcome is because the exclusion of depreciation charges in the USDA and the Melichar approaches are offset by the failure to include accrual adjustments that were generally positive in the year of our sample. Consequently, one could find dramatic differences in classification in years when accrual adjustments are generally negative.

Perhaps the most noteworthy aspect of the classification comparisons is the large number of farms in the stressed or vulnerable categories that were no longer placed in those categories when an accrual-based definition of income is substituted for a cash-based definition of income. Because

of the widespread publicity given to the criteria used by USDA or by Melichar, there is a strong tendency for individual farmers to evaluate their own situation on the basis of those criteria. As our sample data show, those criteria may fail to properly reflect the true financial position of the farming operations.

References

- Barry, P., J. Hopkin, and C.B. Baker. *Financial Management in Agriculture*. 3rd ed. Danville, IL: Interstate Printers and Publishers, 1983.
- Illinois Cooperative Crop Reporting Service. *Illinois Farm Finances*. Springfield: Illinois Cooperative Crop Reporting Service, February 1986.
- Lee, Warren, Michael Boehlje, Aaron Nelson, and William Murray. *Agricultural Finance*. 7th ed. Ames: Iowa State University Press, 1980.
- Lins, D. and D. Klinefelter. "Omissions in Measuring Farm Sector Wealth and Income." *N. C. J. of Agr. Econ.* 4(January 1982):9-17.
- Melichar, Emanuel. "The Farm Credit Situation and the Status of Agricultural Banks." Paper read at the Twin Cities Agricultural Issues Round Table, April 24, 1986, St. Paul, Minnesota.
- Penson, John B., Jr., and David A. Lins. *Agricultural Finance: An Introduction to Micro and Macro Concepts*. Englewood Cliffs: Prentice-Hall, 1980.
- Seeger, Daniel J. and David A. Lins. "Cash Versus Accrual Measures of Farm Income." *N. C. J. of Agr. Econ.* 8(July 1986):219-26.
- U.S. Department of Agriculture, Economic Research Service. *Financial Characteristics of U.S. Farms, January 1985*. AIB 495. July 1985.
- _____. *Financial Characteristics of U.S. Farms, January 1986*. AIB 500. August 1986.

Cattle Feeding Investments: The Impact of the Tax Reform Act of 1986

Clifford Rossi

Abstract

The Tax Reform Act (TRA) of 1986 is expected to affect nonfarm investment in agricultural tax shelters. This study examines the effects of tax reform on nonfarm investment decisions in custom cattle feeding relative to five nonfarm assets. A mean-variance analysis is employed to compare optimal portfolio investment under pre-TRA, phase-in, and fully implemented TRA provisions. Increased investment in cattle feeding programs is expected under the phase-in period of TRA compared with other tax scenarios. Full implementation of TRA could dramatically reduce nonfarm investment in cattle feeding for both active and passive investors.

Key words: tax reform, portfolio investment, cattle feeding, tax shelters.

The Tax Reform Act (TRA) of 1986 is expected to affect returns on different classes of farm and nonfarm assets. Under TRA of 1986, the lowering of marginal tax rates, the loss of certain tax preference items including capital gains provisions, and the restrictions on passive loss activities will reduce after-tax returns on some investments. Tax policy changes not only affect investor portfolio returns but also are likely to alter patterns of investment between economic sectors.

The commercial cattle feeding industry has been widely recognized as a tax shelter for nonfarm investors. Although initially economies of size spurred substantial growth of the cattle feeding industry, some researchers contend that tax policy was a contributing factor in attracting outside investors to custom cattle feeding operations during the past decade or more. For example, in 1964, sales of fed cattle from commercial feedlots represented 39 percent of all cattle marketings. By 1980, more than 73 percent of fed cattle sales were from commercial feedlots (Reimund, et al.). Several structural analyses of the cattle feeding industry have determined that a significant proportion of commercial feeding clients are outside investors. Willett and Menzie for example, claim that more than 70 percent of cattle on feed in Texas, Arizona, and California are owned by nonfarm investors. To the extent that investment in commercial feedlots is tax motivated, it seems plausible that the new tax regulations could improve the general economic climate for farm feedlot operations by requiring cattle feeding investment decisions to be based more on economic returns and less on tax benefits.

This paper examines the effect of tax policy on investment by a nonfarm investor in a portfolio that includes cattle feeding. Incentives for investment in cattle feeding are reviewed, including discussions of the role of

leveraged purchases and deferred tax liability to returns on those investments. A quadratic programming model is used to determine the efficient portfolio composition for six asset types including fed cattle. Scenarios under pre-TRA provisions, a phase-in period for TRA, and full implementation of tax reform are selected for analysis under various combinations of leveraging and required rates of return. Returns to active and passive investment in cattle feeding are compared to assess the importance of participation status for tax purposes. The results from this analysis provide an empirical foundation for assessing the role of tax policy on nonfarm investor decision making.

Risk and Return in Cattle Feeding Investments

Cattle feeding involves a substantial amount of risk during a feeding program. Cattle and input prices and government commodity policies affect cattle feeding programs in the short run. Consumer preferences, substitute products, and disposable income greatly influence the profitability of the venture over a longer time frame. In recent years, the market for cattle has softened due to the placement of large numbers of cattle on feed and the changes in consumer preferences in response to recent articles on heart disease and dietary habits. Savvy nonfarm investors adopt hedging strategies, leveraged purchases, and tax preferences to reduce risk and improve returns to cattle feeding ventures.

Previous Research

Recent research on the effects of tax policy on cattle feeding investment is scarce. In the 1970s a few studies were undertaken to evaluate the impacts of tax reform proposals on cattle feeding investments. Youde and Carman highlight the tax deferral advantages of feeding programs. They claim that outside investment into the industry helps smooth seasonal fluctuations in fed cattle prices with increased returns to feeders. Willett and Menzie analyze the effects of tax policy on fed cattle returns under various income levels and leveraged financing scenarios. They hypothesize that eliminating the deduction for cattle feeding losses would severely impair the attractiveness of the venture for nonfarm investors. They found

that leveraging intensifies the risk exposure in the investment, though it allows for higher returns by reducing the use of equity capital in the program. Other research on cattle feeding focuses on regional characteristics of the cattle feeding industry and clients. Examples of those efforts include Dietrick, Martin, and Ljungdahl's analysis of feeding operations in Texas, and Menzie, Hanekamp, and Phillips' work in Arizona.

None of the above research examine cattle feeding and nonfarm investments under changing tax provisions. Galper and Zimmerman provide some empirical evidence to support the contention that assets that receive preferred tax treatment are held disproportionately by high-income investors. Among the assets examined are custom cattle feeding ventures.

Some work focuses on comparisons of nonfarm and farm investments. Mills and Hoover develop a mean-variance analysis of investment in forest land. They designed three models of investment, each one representing a different portfolio of possible nonfarm and farm investments. They conclude that forest investment enhances portfolio diversification. Moss, Featherstone, and Baker also use a portfolio model to examine the attractiveness of agricultural assets in a portfolio including nonfarm investments. Though cattle feeding investments were not considered, Moss, et al., conclude that farm assets would enter the efficient portfolio based on their risk-return characteristics.

Tax Provisions Affecting Cattle Feeding Investments

Under pre-TRA provisions, prepaid feed expenses, management fees, and hedging costs associated with cattle feeding operations are fully deductible. In addition, interest associated with loans secured for an investment is also deductible. Deducting those expenses from current taxable income boosts the return to cattle feeding investment because income retained as a result of the deductions is equivalent to an interest-free loan from the federal government. Limitations on cash accounting under TRA restrict deductions to 50 percent of qualified prepaid expenses, though the deferral of income is still preserved in the act.

Feeder cattle could not be depreciated under old tax law because the animals are not considered to be used for trade or business. Income received from a program is treated as ordinary income and is not subject to capital gains provisions. Further, the investment tax credit is not allowable for feeder cattle. Under pre-TRA provisions, passive losses could be written off against nonpassive income if the following conditions are met: (a) the program is designed to turn a profit, and (b) the investor is "at risk" with respect to the investment. Investors receive full tax benefits by placing cattle on feed near the end of the tax year and by prepaying expenses.

TRA of 1986 restricts the use of passive losses to offset nonpassive income. Under full implementation of TRA, deductions for cattle feeding ventures are not allowed to offset nonpassive income unless material participation in that activity can be demonstrated. A taxpayer is considered to be a material participant in an activity if there is involvement on a regular, continuous, and substantial basis. Material participation for agricultural enterprises is based on such factors as the type and extent of decision making, time devoted to the activity, and proximity of the investor to that enterprise.

Phase-in of passive loss restrictions occurred for investments made on or before December 1986. Sixty-five percent of passive losses for tax year 1987, 40 percent for 1988, 20 percent for 1989, and 10 percent for 1990 can be deducted from income. After 1990, no deductions will be permitted unless passive income is generated in that tax year. Cattle feeding returns under break-even conditions will fall to zero in the long run for investors without passive income if the Internal Revenue Service (IRS) narrowly interprets material participation by nonfarm investors.

Reductions in marginal tax rates will be of much interest to cattle investors. Investors in the 50 percent tax bracket under pre-TRA provisions will be subject to a 38.5 percent reduction during the phase-in period for 1987, which will fall to 28 percent under the fully implemented plan.¹ That will reduce the amount of deductions that can be reinvested

from sheltered income in the applicable tax year. The phase-in period of TRA should improve cattle feeding returns because investors can claim deductions under the 50 percent tax rate against 1986 income and be taxed at the 38.5 percent rate on income in 1987 when the cattle are sold. A discussion of the returns to cattle feeding in light of leveraging and tax deductibility follows to show how they affect returns on investment.

After-Tax Returns to Cattle Feeding

An analysis of the effect of leveraging and tax policy on cattle feeding returns is presented using a historical data series on feeder cattle and introducing some assumptions about investors. A return to investment is defined in this analysis as the ratio of the proceeds from the reinvested deferred income to the cash outlay of the investor. It assumes an investor in the highest tax bracket under pre-TRA law, that is, the 50 percent class making an investment on a pen of 250 cattle for 1986. Costs for the program include the purchase of feeder steers, feed costs for a 180-day program, medicine and veterinary expenses, a death loss cost, interest on a loan, and hedging expenses.

This analysis used USDA aggregate data of cattle on feed in the Great Plains region. The aggregate data do not represent individual feedlot costs. Most of the period selected for review, 1977-86, reported negative net margins in commercial cattle feeding according to USDA. Given the problem with the aggregate data series, it is assumed that the investor hedges to exactly break even on the venture before taxes, thus the only gain is from the reinvestment of deferred income for one year.

Feeder steers were assumed to be sold at 1,056 pounds. A cost for death loss was estimated at 1.5 percent of the purchase price of the animals (USDA). In discussions with commercial feedlot representatives, break-even hedging costs were estimated at \$16 per head. Medical and vet expenses were estimated by USDA at \$24 per head for each year of the study period. Nominal steer and feed costs associated with the program were obtained from USDA.

For this analysis, three leveraging scenarios

¹There will be an additional 5 percent surcharge on taxpayers within certain income classes.

were examined. One case assumed that the investor provided 50 percent of the funds for the venture, with a financial institution supporting the remaining 50 percent (50 percent leveraging). Another scenario assumed the individual covered 33 percent of investment costs (67 percent leveraging), and the third example assumed that the investor made only a 20 percent investment of own funds into the program (80 percent leveraging). Loan interest was based on annual market rates, computed for a 180-day period, and annualized.

Expenses immediately deductible under pre-TRA tax law include feed, management fees, hedging costs, and interest. Taxable income is deferred based on deductions taken for cattle feeding. That income is assumed to be reinvested in assets offering market returns for a one-year holding period. Under pre-TRA provisions, a 50 percent marginal tax rate is applied, and under full implementation and phase-in of TRA, a 28 percent and 38.5 percent rate are used, respectively. Under full implementation of the plan, cattle feeding results in a zero return for the nonfarm passive investor. Even for programs where the investor qualifies as an active participant, returns are likely to be lower for cattle feeding than under pre-TRA law due to the change in cash accounting provisions restricting the deduction for prepaid expenses to 50 percent of qualified costs. Table 1 highlights comparative returns under alternative scenarios.

The standard deviation associated with the expected returns was extremely low as would be anticipated from the break-even assumption. The range of the standard deviation under the four tax scenarios was 1 to 2 percent.

As is evident from Table 1, the phase-in period offers the highest returns compared

with other tax policies because investors can take larger deductions using a 50 percent tax rate and can defer tax payments to the following year at the lower rate of 38.5 percent.

The degree of leveraging makes much difference on the return to the feeding program. Summarizing from the table, as leveraging increases, the expected return on the investment becomes greater. This analysis provides a simplistic view of the cattle feeding venture holding constant the returns and risk from other competing assets. A more complete evaluation of how tax policy and leveraging affects investment can be determined from a detailed optimal portfolio analysis presented below.

Mean-Variance Analysis

A model using a mean-variance (M-V) methodology was developed to evaluate portfolio mix for a nonfarm investor. Theoretically, a rational investor optimizes some personal utility function with respect to returns and risk associated with investments in a portfolio. The basic model algebraically can be defined as

$$\text{MIN } Z = X' \Sigma X$$

s.t.

$$X'U = E$$

$$X'1 = 1 \quad i = 1, 2, \dots, n$$

$$X \geq 0$$

where, X is a vector of asset proportions in the portfolio, U is a vector of expected returns from n investments, Σ is the variance-covariance matrix, 1 is a unit vector, and E is the target rate of return. The model states that investors minimize portfolio risk subject

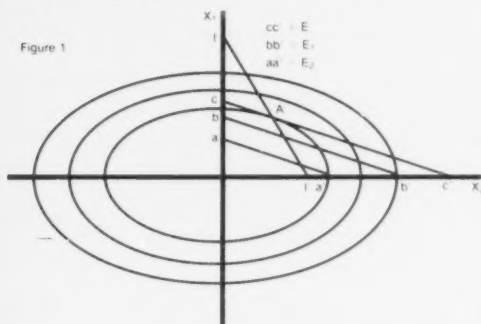
Table 1. After-Tax Returns on Cattle Feeding

Tax Scenario	Investor Leveraging ^a		
	80%	67%	50%
Pre-TRA Provisions	6.25	3.75	2.5
Phase-in	7.69	4.61	3.07
Full Implementation, Passive	0	0	0
Full Implementation, Active	2.52	-1.51	1.00

^aExpressed in percent.

to a target portfolio return. Further, all asset shares must sum to one, and there can be no short-selling in the model, that is, all shares are nonnegative.

The graphical representation of the model (Figure 1) clarifies the investor's portfolio selection problem.



For this example, there are only two assets, X_1 and X_2 . The concentric ellipses represent iso-variance levels; each ring denotes a constant level of variance or risk. A move toward the origin represents a lower variance. The parallel line segments aa' , bb' , and cc' are iso-revenue lines; each line represents a constant level of return to an investment. A budget constraint I' completes the model, with the requirement that all asset shares must sum to one. For the mean-variance model, the point of optimality is represented in the diagram by A and is found to be the portfolio that minimizes variance at target return E and meets the budget constraint that all portfolio shares sum to one. The conceptual model is employed in the next section for five nonfarm assets and cattle feeding.

Assumptions Behind the Methodology

For this analysis, six different asset types are examined. They are the *Standard and Poor's* 500 composite common stock index, one-year Treasury bills, five-year to seven-year Treasury notes, twenty-year to thirty-year Treasury bonds, a composite of corporate Aaa grade bonds, and cattle feeding. The expected returns and variance of each asset are computed based on data from 1977-86. (*Moody's* and U.S. Department of the Treasury). The time frame was selected to better reflect recent market conditions. The

analysis focuses on tax provisions in 1986 (pre-TRA), 1987 (phase-in of TRA), and post-1987 (fully implemented TRA). The following expression is used to compute the rate of return for the six asset classes

$$R_t = (P_t - P_{t-1}) / P_{t-1}$$

where R_t is the rate of return in period t , and P_t is the asset's market price in t . For this analysis, a one-year holding period is assumed, though very easily this analysis could be extended to include much longer holding periods. Taxes are introduced into the expected return calculation by the following expression

$$U_t = (1 - t_g) R_t + (1 - t_o) D_t$$

where E is the after-tax rate of return, R_t is defined as before, t_o is the tax rate on ordinary income, D_t is the cash dividend received in t for common stocks or the annual coupon payment on bonds, and t_g is the capital gains rate of return.

For this analysis, only the appreciation from common stocks is eligible to receive the more favorable capital gains rate of 20 percent. Treasury bills do not receive coupon payments but instead are sold at a discount. Treasury notes and bonds and corporate bonds are assumed to be purchased at a discount (original issue discount), which is taxed as ordinary income under IRS regulations. The after-tax rates of return and standard deviations for the five nonfarm investments are presented in Table 2.

In the last ten years, common stock returns have experienced considerable fluctuation as indicated by the size of the standard deviation. Alternatively, T-bills offer the lowest risk among the asset classes shown. Corporate and long-term Treasury bonds experienced a significant amount of variation in returns due in part to the effects of interest rate changes during the period.

Returns on common stock are highest among nonfarm assets for all tax scenarios. Those returns are lower under the phase-in of TRA than returns under pre-TRA tax law. The decline in ordinary income tax rates is not great enough to offset the loss of capital gains tax preferences for common stocks. After-tax returns on stocks are highest under full implementation of TRA when the lower

Table 2. After-Tax Rates of Return and Risk for Nonfarm Investors

	Stocks	T-Bills	Asset Corporate Bonds	Treasury Bonds	Treasury Notes
<i>Tax Plan</i>					
Pre-TRA Law	11.14%	4.67%	3.95%	3.34%	3.78%
Phase-in TRA	10.93	5.74	4.85	4.1	4.65
Fully Implemented TRA	11.51	6.72	5.68	4.8	5.44
Standard Deviation	14.71	3.09	13.4	12.35	8.36

Table 3. Tax Policy Effects on Optimal Portfolio Selection of a 3 Percent Target Return^a

Return			Portfolio Share					
Tax Scenario	Objective Function	Portfolio Returns	Common Stock	T-Bills	Corporate Bonds	Government Bonds	T-Bills	Cattle Feeding
50% Leveraging Scenario								
Pre-TRA law	.85	3	0	23	0	0	0	77
Phase-in of TRA	.47	3.18	0	4	0	0	0	96.93
Full Implementation of TRA Active	2.84	3	0	34.59	0	0	.48	64.93
67% Leveraging Scenario								
Pre-TRA law	1.12	3.84	0	9.4	0	0	0	90.6
Phase-in of TRA	1.14	4.72	0	9.4	0	0	0	90.6
Full Implementation of TRA Active	2.75	3	0	28.6	0	0	0	71.4
80% Leveraging Scenario								
Pre-TRA law	2.75	5.84	0	26.25	0	0	0	73.75
Phase-in of TRA	2.75	7.18	0	26.25	0	0	0	73.75
Full Implementation of TRA Active	2.75	3.62	0	26.25	0	0	0	73.75

^aFigures expressed in percent.

rate of 28 percent becomes effective. Corporate and government bonds do not appear nearly as attractive as other investments based on their risk and return. For example, an investor could obtain a higher return at lower risk from five-year to seven-year T-notes and T-bills than with long-term bonds. It would be surprising then to find long-term bonds held in any significant amount in the optimal portfolio in the subsequent analysis.

Tax Policy Effects on Cattle Feeding Ventures and Portfolio Selection

Tax policy plays a major role in shaping investor portfolio preferences. The model is sensitive to key parameters such as leveraging and target returns, which causes a substantial amount of variation between scenarios for portfolio investment in cattle

Table 4. Tax Policy Effects on Optimal Portfolio Selection of a 5 Percent Target Return^a

Return			Portfolio Share					
Tax Scenario	Objective Function	Portfolio Returns	Common Stock	T-Bills	Corporate Bonds	Government Bonds	T-Bills	Cattle Feeding
50% Leveraging Scenario								
Pre-TRA law	8.23	5	10.33	74.06	0	0	.01	15.6
Phase-in of TRA	4	5	6	54	0	0	0	40
Full Implementation of TRA Active	4.76	5	2.38	62.3	0	0	4.2	31.12
67% Leveraging Scenario								
Pre-TRA law	5.61	5	12	43	0	0	0	45
Phase-in of TRA	2.81	5	.6	31.4	0	0	0	68
Full Implementation of TRA Active	4.5	5	2.32	59.79	0	0	3.65	34.25
80% Leveraging Scenario								
Pre-TRA law	2.75	5.84	0	26.25	0	0	0	73.75
Phase-in of TRA	2.75	7.18	0	26.25	0	0	0	73.75
Full Implementation of TRA Active	3.89	5	2.11	52.92	0	0	2.33	42.64

^aFigures expressed in percent.

feeding. Three tax policies are discussed for each combination of leveraging and target return scenario.

Tax Effects Under 50 Percent Leveraging

Overall, the phase-in of TRA appears to be most favorable to cattle feeding operations among tax scenarios. With a 3 percent required return, the phase-in scenario shows 96 percent of the portfolio invested in cattle feeding (Table 3). In contrast, under pre-TRA tax law, 77 percent is invested in fed cattle programs. If an investor can demonstrate active participation, then under full implementation of TRA cattle feeding shares decline to about 65 percent. Passive investors are less likely to invest in cattle feeding in this analysis once TRA is fully implemented given the assumptions about break-even hedging and eligible tax deductions.

Note that with a 5 percent required return, cattle feeding represents 40 percent of the optimal portfolio during the phase-in period,

significantly more than the 16 percent share under pre-TRA conditions (Table 4). With active status under full implementation, investment in cattle feeding actually is greater than under old tax law. To achieve the 5 percent required return under full implementation, an investor can place a greater proportion of the portfolio into cattle feeding than under pre-TRA law because the return to T-bills exceeds the target rate by enough to offset the low return to cattle feeding. By allocating the portfolio on that basis, the investor effectively reduces risk by about one-half.

With a 7 percent required return, investment in cattle feeding under all tax policies is zero (Table 5). That can be attributed to low rates of return on cattle feeding relative to the target rate.

Tax Policy Effects Under 67 Percent Leveraging.

For a 3 percent required return, pre-TRA and phase-in of TRA scenarios increase to about

Table 5. Tax Policy Effects on Optimal Portfolio Selection of a 7 Percent Target Return^a

			Portfolio Share					
Tax Scenario	Objective Function	Portfolio Returns	Common Stock	T-Bills	Corporate Bonds	Government Bonds	T-Bills	Cattle Feeding
50% Leveraging Scenario								
Pre-TRA law	32.91	7	36	64	0	0	0	0
Phase-in of TRA	18.98	7	24.3	75.7	0	0	0	0
Full Implementation of TRA Active	9.16	7	7.12	88.1	0	0	4.78	0
67% Leveraging Scenario								
Pre-TRA law	32.91	7	36	64	0	0	0	0
Phase-in of TRA	18.98	7	24.3	75.7	0	0	0	0
Full Implementation of TRA Active	9.16	7	7.12	88.1	0	0	4.78	0
80% Leveraging Scenario								
Pre-TRA law	9.33	7	15.50	0	0	0	0	84.5
Phase-in of TRA	2.75	7.18	0	26.25	0	0	0	73.75
Full Implementation of TRA Active	9.16	7	7.12	88.1	0	0	4.78	0

^aFigures expressed in percent.

91 percent of the portfolio invested in fed cattle ventures as compared with 77 percent under 50 percent leveraging (Table 3). Leveraging significantly affects portfolio selection under most tax scenarios. Under 67 percent leveraging portfolio shares in cattle feeding increase primarily because returns to the investment increase with more leveraging. Under full implementation for an active participant, shares in cattle feeding fall to 71 percent. Reduced deductions and higher returns to alternative investments offset the advantages of lower tax rates on cattle feeding taxable income.

For a 5 percent required return scenario, cattle feeding portfolio shares are highest under the phase-in period (68 percent), followed by pre-TRA law (45 percent), and full implementation with active status (34 percent) (Table 4). A 7 percent required return effectively eliminates cattle feeding from the optimal portfolios under 67 percent leveraging (Table 5).

Tax Effects Under 80 Percent Leveraging

As leveraging increases to 80 percent, the difference between cattle feeding shares under alternative tax scenarios declines. For instance, with a 3 percent required return, investment in cattle feeding for all tax scenarios equals about 74 percent (Table 3). Increased leveraging results in high cattle feeding returns relative to a low target return across tax scenarios, and consequently, fed cattle shares are the same.

With a 5 percent required return, shares in cattle feeding for both pre-TRA provisions and the phase-in period equal about 74 percent (Table 4). Under full implementation and active status, cattle feeding shares decline to about 43 percent, indicating that the tax scenario has a substantial negative effect on investor preferences for fed cattle.

When a 7 percent required return is imposed, cattle feeding shares are about 85 percent

under pre-TRA tax law and 74 percent under the phase-in of TRA but disappear under full implementation (Table 5). Eighty percent leveraging under favorable tax scenarios (pre-TRA and phase-in of TRA) dramatically increases cattle feeding returns, making the venture more attractive than either of the other leveraging scenarios.

Does Active or Passive Participation Affect Cattle Feeding Investments?

Under most scenarios, investor participation is a significant factor in fed cattle investments by nonfarm investors. Table 6 below describes the portfolio composition when cattle feeding investment is treated as passive income for a 3 percent and a 5 percent target return.

Table 6. Portfolio Composition for Passive Income

Asset	Assumption for Cattle Feeding Portfolio Share*
Common Stock	1.23%
T-Bills	87.4 %
Corporate Bonds	0
Government Bonds	0
T-Notes	11.37%
Cattle Feeding	0
Total	100 %

*Portfolio returns equal 6.63 percent, objective function equals 8.37.

With active participation status, cattle feeding is about 74 percent of the portfolio under 80 percent leveraging and a 3 percent target return (Table 5). Passive status for cattle feeding results in a zero return for the investment given the assumptions of the model, hence a zero share of the portfolio. Status is irrelevant with a 7 percent required return where cattle feeding portfolio shares for both passive and active investors equal zero. Under all other scenarios, the impact of participation status depends on required returns and leveraging. In general, when the target rate is higher, the impact of status is smaller. Moreover, as leveraging increases, the importance of participation increases.

Tax Policy, Nonfarm Asset Returns, and Portfolio Composition

Optimal portfolio composition offers some interesting insights into the relative

attractiveness of the assets included in this analysis. Note that for pre-TRA tax law and phase-in of TRA, some combination of common stocks, T-bills, and T-notes enter into solution with cattle feeding under most scenarios. Long-term bonds never enter into solution. A reason for that is returns and risk associated with those investments are not nearly as attractive as those of other alternatives. There also appears to be a bias toward T-bills over other nonfarm assets under the various tax provision scenarios. Five-year to seven-year T-notes come into solution for most of the strategies examined under full implementation. T-note and T-bill returns rise relative to those under the other tax scenarios, making them a more attractive investment under the full implementation tax scenario.

Observations and Conclusions

Results from this research are based on a normative modeling approach and should not be interpreted as forecasts for all investors. This analysis has presented a number of results relating to cattle feeding investments under a variety of tax and financial scenarios. Of the three tax scenarios, phase-in of tax reform results in higher returns for cattle feeding. However, the advantages of the phase-in provisions can only be enjoyed for one year. Full implementation of TRA reduces overall the advantages of feeding cattle found under pre-TRA law and the phase-in period. The decisive factor for nonfarm investors in considering cattle feeding ventures is whether the investor can meet the material participation standards.

Further work could be conducted to enhance this research. A model that maximizes portfolio returns subject to target levels of risk should be developed, and results should be compared with alternative investor objectives such as the minimization of portfolio risk. Another area of related research that remains undeveloped is an analysis of the effects of tax reform on cattle feeding supply. That work would complement the microeconomic analysis of investor decision making presented here.

There could be significant effects from tax policy on the aggregate supply of fed cattle.

If phase-in of tax reform encourages short-term investment in cattle feeding, there could likely be some downward pressure exerted on cattle prices at a time when the industry has been suffering from low prices. A bright spot for farm feedlot operators is that full implementation of the new tax reform plan could reduce existing tax shelter incentives and force a significant amount of tax-motivated nonfarm investment out of the industry. If that scenario were to occur, market prices for cattle could rise. There appears to be a great deal at stake for nonfarm investors regarding the status of their participation in such activities. The after-tax financial appeal of cattle feeding will effectively be eliminated for investors who do not generate passive income if IRS refuses to grant active status to nonfarm investors.

References

- Chen, S. "Optimal Portfolio Selection Under Differential Taxation: Simple Rules." *Quarterly Rev. of Econ. and Bus.* 26(1986):6-16.
- Dietrick, R.A., J.R. Martin, and P.W. Ljungdahl. *The Capital Structure and Financial Management Practices of the Texas Cattle Feeding Industry*. B-1128. Texas Agricultural Experiment Station, 1972.
- Galper, H., and D. Zimmerman. "Preferential Taxation and Portfolio Choice: Some Empirical Evidence." *National Tax Journal* 30(1977):387-97.
- Kroll, Y., H. Levy, and H.M. Markowitz. "Mean-Variance Versus Direct Utility Maximization." *J. of Fin.* 39(1984):47-61.
- Levy, H., and H.M. Markowitz. "Approximating Expected Utility by a Function of Mean and Variance." *Amer. Econ. Rev.* 69(1979):308-17.
- Levy, H., and M. Sarnat. *Portfolio and Investment Selection: Theory and Practice*. New York: Prentice-Hall, 1984.
- Menzie, E.L., W.E. Hanekamp, and G.W. Phillips. *The Economics of the Cattle Feeding Industry in Arizona*. Technical Bulletin 207. University of Arizona Agricultural Experiment Station, 1973.
- Mills, W.L., and W.L. Hoover. "Investment in Forest Land: Aspects of Risk and Diversification." *Land Economics* 58(1982):33-51.
- Moody's Investor Service. *Moody's Bond Record*. Various issues, 1977-86.
- Moss, C.B., A.M. Featherstone, and T.G. Baker. "Stocks, Bonds, Bills, and Farm Assets: A Portfolio Analysis." Paper presented at the American Agricultural Economics Association annual meeting, Reno, Nevada, August 1986.
- Reimund, D.A., J. Martin, and C. Moore. *Structural Change in Agriculture: The Experience for Broilers, Fed Cattle, and Processing Vegetables*. TB-1648. Economic Research Service, U.S. Department of Agriculture, 1981.
- Salomon Brothers, Inc. *1983-84 Bond Market Analysis and Outlook*. New York: Salomon Brothers, Inc., 1984.
- Shrieves, R.E., and J.M. Wachowicz. "A Utility Theoretic Basis for 'Generalized' Mean-Coefficient of Variation (MCV) Analysis." *J. of Fin. and Quant. Analysis* 16(1981):671-83.
- Texas Cattle Feeders Association. *1986 Cattle Feeders Annual*. Amarillo: Texas Cattle Feeders Association, 1986.
- U.S. Department of Agriculture, Economic Research Service. *Characteristics of Farmer Cattle Feeding*. AER 503 prepared by R.N. Van Arsdall and K.E. Nelson, 1983.
- _____. *Livestock and Poultry. Situation and Outlook Report*. Various issues, 1977-86.
- Willett, G.S., and E.L. Menzie. "Tax Shelter Law Reform Could Hurt Beef Feeders." *Arizona Review* 22(1973):5-9.
- Youde, J.G., and H.F. Carman. "Tax-Induced Cattle Feeding." *California Agriculture* 26(1972):13-15.

The Impact of Federal Budget Deficits on the Cost of Agricultural Credit

Catharine M. Lemieux

Abstract

The impact of federal budget deficits on the cost of credit in the farm sector is examined using a disaggregated model of the U.S. financial sector. Budget deficits are shown to affect the level and structure of all interest rates in the economy. However, the interest rates on farm loans are shown to be more responsive to crowding out than interest rates in the nonfarm sector. Interest rates, in general, exhibit an inelastic response to changes in the budget deficit. In the short run, monetizing the deficit can partially counteract the effects of federal budget deficits on interest rates.

Key words: federal budget deficits, Production Credit Association interest rates, Federal Land Bank interest rates, prime interest rate, macro financial modeling.

The impact of budget deficits and monetary policy on agriculture has never been more apparent than in the 1980s. Agriculture today is a capital-intensive, debt-dependent, and export-dependent sector. Current fiscal and monetary policies are creating an environment where inflation is low and real interest rates are high. According to Robert Thompson, former assistant secretary for economics, U.S. Department of Agriculture (USDA), "The large increase in total farm debt accumulated over the 1970s together with the high real interest rates of the 1980s meant that the interest rate really became the single most important price affecting the farmer's bottom line." According to USDA, interest expenses equaled 85 percent of net farm income during the first half of the 1980s.

The interest rates farmers must pay for new loan funds are a reflection of the interest rates in the general economy. The government securities market represents a primary transmission mechanism for macroeconomic policy in this country. Federal Open Market Committee action or inaction in that market has a great deal to do with the degree to which Treasury borrowing affects interest rates in that and other financial markets. The loan funds market serving agriculture is no exception. Commercial banks, Farm Credit System (FCS), and Farmers Home Administration (FmHA) supplied 75.6 percent of the outstanding agricultural credit in 1985 according to the USDA. The cost of loanable funds for both the FmHA and the FCS is directly tied to interest rates in the U.S. government securities market, which represents their principal source of loanable funds. The cost is passed along to farmers through the interest rates the intermediaries charge on new loans. The amount of funds commercial banks are willing to lend to the agricultural sector depends upon the risk-

return trade-off between agricultural loans and other possible investments, such as the purchase of Treasury securities. Thus, an understanding of the impact of federal budget deficits on interest rates in the U.S. government securities market and how those changes are transmitted to the agricultural and nonagricultural loan funds market is critical to projecting future changes in farm interest rates.

The objective of this analysis is to investigate the effects of large federal budget deficits on the cost of credit in the agricultural sector and to investigate the relative responsiveness of farm and nonfarm interest rates to changes in fiscal and monetary policy. A review of recent work on the empirical relationship between budget deficits and real interest rates, the theoretical basis for the structure of the model, the estimation results, the simulation results for an increase in the real budget deficit, and the conclusions that can be drawn from this research are presented in the following sections.

Federal Deficits and Real Interest Rates

Much quantitative analysis has been devoted to verifying the theoretical relationship between deficits and real interest rates. Several studies have failed to find a significant link between federal budget deficits and real interest rates (Evans 1985 and 1987; Motley; and Hoelscher). Each of those researchers specify interest rates as a function of two separate variables—budget deficits and money supply—which represent fiscal and monetary policy, respectively. However, if interest rates are determined by the supply of securities to the public, then it is the net (new issues less rollovers) rather than the gross quantity of securities supplied that influences the interest rate. Including the variables separately, rather than netting them out, fails to properly explain changes in the supply of government securities to the public due to the combined action of Treasury issues and federal open market operations.

Considering changes in the supply of credit due to fiscal policy without considering changes in the supply of credit due to compensatory monetary policy leads to

results that only account for a portion of the variation in interest rates. Hutchison and Pyle found that they could explain the sharp increase in real interest rates between 1980 and 1982 by accounting for both the increase in federal budget deficits and slower monetary growth.

Roley; Friedman, Feldstein and Eckstein; Sinai and Rathjens; and Hutchison and Pyle all found a significant positive link between federal budget deficits and real interest rates. Hutchison and Pyle use pooled cross-sectional data for seven countries over a more recent time period than is used in the other studies mentioned above. Roley; Friedman; and Sinai and Rathjens employ a structural approach to interest rate modeling. Modeling interest rates in a general equilibrium framework allows the indirect effects of budget deficits on income and other variables to impact the estimates. Large scale macromodels such as the MIT-PENN-SSRC (MPS) model and the Federal Reserve Board's multicountry model demonstrate a substantial increase in interest rates due to a given fiscal stimulus. It shows that, in fully simultaneous systems, budget deficits positively influence real interest rates.

Friedman reformulated the MPS model to include a market-clearing equilibrium condition; that is, the quantity of securities sold by the Treasury to finance the deficit minus the quantity purchased by the Federal Reserve equals the quantity purchased by investors. Friedman found that structural modeling of financial assets, where asset demands are a function of portfolio-theoretic constraints, captures more portfolio balance interactions than are typically found when using conventional unrestricted reduced-form equations. Including that constraint made an important difference in judging the effectiveness of both monetary and fiscal policies.

Methodology

To analyze the effect of large deficits on the farm sector a disaggregated structural model of the U.S. financial markets is needed. Without disaggregation by asset, debt instrument, and sector the impact of those economywide events on agricultural lenders and producers is difficult to assess.

This analysis relies on a comprehensive portfolio balance model of the U.S. financial sector described by Lemieux. The major effects of fiscal and monetary policy come from the supply side of financial markets. Macroeconomic linkages are captured through the influence of changing interest rates on investor's portfolio composition. Fiscal policy is transmitted through the size of the federal budget deficit, which is a determinant of the interest rate on government securities. Monetary policy is determined by the size of the monetary base, which is calculated as the sum of endogenously determined borrowed reserves plus exogenously determined nonborrowed reserves and currency. The effects of monetary policy on the financial sector are seen principally through the impact of federal open market operations on nonborrowed reserves and, thus, the monetary base and the interest rates on government bonds; the effect of the discount rate on borrowed reserves, which in turn, affects the prime lending rate; and the effect of reserve requirements and the ceiling rate payable on time deposits on the effective interest rate on demand deposits and time deposits. Modeling interest rates in an equilibrium framework allows the full impact of changes in the economy to be traced through all the financial markets to the agricultural loan funds market.

The major contribution of this study is its scope, structure, and disaggregation. The model contains 111 endogenous equations, and it models investor demands for the following financial assets and liabilities: Treasury bills, demand deposits, time deposits, government bonds, agency bonds, corporate bonds, equities, a residual asset category, nonfarm real estate debt, and nonreal estate debt. A model where the investment decisions of one sector impact interest rates on all financial assets and liabilities results when the demand equations are disaggregated by investor group, and tied to interest rates through portfolio considerations.

In keeping with the work done by Penson; Roley; Friedman; Backus et al.; and others interest rates are hypothesized to be a function of the interaction between investor demands and the supply of financial assets, which is influenced by fiscal and monetary

policy actions. The interest rate equations can be specified as follows:

$$r_j = f(DFA_{i,j}, r_j, r_k, X_j) \quad (1)$$

$$r_k = f(DDT_{i,k}, r_j, r_k, X_k) \quad (2)$$

where

$DDT_{i,k}$ = stock of the k th type of debt demanded by the i th investor group,

$DFA_{i,j}$ = stock of the j th financial asset demanded by the i th investor group,

i = i th investor group; there are I number of groups,

j = j th financial asset; there are J financial assets,

k = k th type of debt; there are K types of debt,

r_j = interest rate on financial assets other than r_p

r_k = interest rate on debt other than r_k ,

X_j = supply shifters for asset j ,

X_k = supply shifters for debt k .

In the formulation a particular interest rate is a function of the aggregate demand for that security, interest rates on other assets and debt, and supply shifters. Examples of supply shifters are policy variables such as the discount rate and the ceiling interest rate on time deposits.

Investors' expectations are believed to be important determinants of interest rates (Mishkin; Backus, et al.). Muth proposes the theory of rational expectations that states that investors' decisions reflect their best forecasts of the future using all available information. Because expectations are themselves unobservable, there have been many proposals for incorporating expectations into demand models. A common proxy for expectations is the weighted average of past interest rates or the relevant variables used to forecast interest rates. Some problems with that approach in the specification presented above are that the inclusion of the lagged dependent variable in the demand equations not only implies a particular weighted average for past rates but also for all other independent variables. Additionally, Silber argues that it is the differential movements in various interest rates rather than the level of interest rates that are relevant to portfolio decisions. Because all interest rates tend to move together, it is probable that expectations tend to cancel each other out.

Because of the general equilibrium nature of the model, changes in any particular interest rate are linked to all financial asset and liability markets as portfolio demand adjusts to shocks in the system. For example, changes in the interest rate on government securities affect interest rates on corporate bonds, agency bonds, and business loans. Changes in the prime lending rate, in turn, affect the rates on time deposits, agency bonds, and FCS debt. In this manner the impact of fiscal and monetary policy is eventually transmitted to the farm sector.

Coefficients in the model developed in this study are estimated using ordinary least squares (OLS) and are based on twenty-eight annual observations from 1953–80. Theoretically the use of OLS results in inconsistent estimates because the yields as well as investors' demands for financial assets and liabilities are jointly determined. However, there is some justification for the continued use of that procedure.

Howrey et al., justifies the use of OLS with the following arguments: (a) OLS is relatively inexpensive, and the computations are easy to explain; (b) the superiority of other methods of estimation is not evident when such measures as variance and mean squared error are considered instead of reduction in bias; and (c) many structural models are so large that none of the consistent structural estimators, such as three-stage least squares or full information maximum likelihood, can be used without modification. Either the covariance matrix of errors is arbitrarily restricted, or a subset of the exogenous variables must be selected as first stage regressors. Challen and Hagger point out that using analytical asymptotic results to compare system estimators results in ranking OLS as the least desirable system estimator. However, they state that as departures from textbook assumptions are considered, particularly in the case of large systems (models having either more predetermined variables or stochastic equations than sample points), "such evidence as there is gives OLS the edge" (p. 135). The model developed in this study is estimated using twenty-eight annual observations of 111 endogenous variables and 102 exogenous variables and, thus, qualifies as being large.

Annual observations are used instead of monthly or quarterly data for several reasons: (a) the timing between the actual deficit and the Treasury financing of that deficit may not coincide over shorter time periods, (b) annual data are less distorted by transitory shocks in interest rates that may conceal the underlying relationship between real interest rates and the budget deficit in quarterly or monthly data, and (c) the portfolio adjustment lags to changes in the supply of credit may take longer than a month or a quarter to complete.

Although complete data are available through 1983, the sample period is terminated in 1980 in order to have actual observations to compare with the baseline projections of the model. Year-end values are used for stock variables, and averages of monthly figures are used for annual interest rates. All variables are expressed in real terms. Stocks are adjusted to real terms by using the GNP deflator, and interest rates are adjusted on the basis of the Fisher relationship using the percentage change in the GNP deflator as a measure of inflation. This discussion focuses on how fiscal and monetary policies impact the cost of capital for agricultural producers; thus, only the estimation results for selected supply equations are presented.

Model Estimation

Variable definitions are presented in Table 1, and estimation results for some of the supply equations in the model are presented in Table 2. An increase in the supply of government securities increases r_{GB} . It is through r_{GB} that the impact of fiscal policy is transmitted to the lending sector. *DDMBFOR* measures the federal budget deficit financed by domestic investors. This variable is constructed by subtracting the change in monetary base (the sum of borrowed reserves, nonborrowed reserves, and currency) and the change in foreign holdings of U.S. securities from the federal budget deficit as reported in the *National Income and Product Accounts* (federal expenditures less federal receipts, budget items only). *DDMBFOR* is a measure of the supply of government bonds to domestic investors. Therefore, the actual budget deficit rather than an adjusted series is used in this estimation. Liberal fiscal policy, as evidenced by increases in the federal budget deficit,

Table 1. Definition of the Variables in the Reported Equations

	Variable Description
AB_{TOT}	= total demand for agency bonds by all investor groups
$DDMBFOR$	= measure of the amount of the federal budget deficit that must be financed by domestic public investors
$DT_{FOFLPCS}$	= total farm debt less farm debt held by the Farm Credit System
$EXRES$	= a measure of funds depository institutions have available to lend
r_{AB}	= interest rate on agency bonds
r_{CB}	= interest rate on corporate bonds (seasoned issues, all industrial)
r_{CL}	= prime lending rate for short-term business loans
r_D	= federal reserve discount rate
r_{FLB}	= interest rate on new loans made by Federal Land Bank
$r_{FLB,t-1}$	= interest rate on new loans made by Federal Land Bank lagged one period
r_{GB}	= interest rate on twenty-year U.S. Treasury notes and bonds
r_{MAX}	= maximum allowable interest rate on savings deposits
r_{PCA}	= interest rate on new nonreal estate loans made by Production Credit Associations
r_{TB}	= interest rate on three-month Treasury bills in the secondary market

Table 2. Estimation Results for Selected Supply Equations¹**Interest Rate on Long-Term U.S. Government Securities**

$$r_{GB} = -.05 + .008*DDMBFOR + .19*r_{TB} + .17*r_{MAX} + .61*r_{CB}$$

(-.38) (1.49) (3.70) (4.63) (9.52)

$$R^2 = .95 \text{ Within sample } U1^2 = .25 \text{ Ex post } U1 = .25$$

Interest Rate on Agency Bonds

$$r_{AB} = 1.61 + .21*r_{CL} + .84*r_{GB} - .007*AB_{TOT}$$

(13.31) (4.08) (12.60) (-3.58)

$$R^2 = .95 \text{ Within sample } U1 = .26 \text{ Ex post } U1 = .28$$

Prime Lending Rate

$$r_{CL} = .70 - .009*EXRES + .86*r_D + .17*r_{TB}$$

(2.01) (-2.59) (2.62) (.55)

$$R^2 = .81 \text{ Within sample } U1 = .24 \text{ Ex post } U1 = .47$$

Interest Rate on Federal Land Bank Loans

$$r_{FLB} = -1.15 - .50*r_{CL} + 1.42*r_{AB} + .17*r_{FLB,t-1}$$

(-5.67) (-7.15) (15.44) (3.07)

$$R^2 = .95 \text{ Within sample } U1 = .31 \text{ Ex post } U1 = .34$$

Interest Rate on Production Credit Loans

$$r_{PCA} = 2.88 + .24*r_{CL} + .83*r_{AB} - .07*DT_{FOFLPCS}$$

(7.61) (2.94) (8.76) (-9.47)

$$R^2 = .95 \text{ Within sample } U1 = .21 \text{ Ex post } U1 = .25$$

¹Values in parentheses are *t* statistics.²Theil's inequality coefficient.

positively affects the real interest rate on government bonds by increasing *DDMBFOR*. Liberal monetary policy, through either the impact of open market operations on nonborrowed reserves or the impact of the discount rate on borrowed reserves, negatively affects the real interest rate on government bonds by lowering *DDMBFOR*. Although the variable is significant at less than 20 percent, the simulation results show that supply considerations prove to be more important in forecasting future rates.

The long-term interest rate on government bonds is also positively related to r_{MAX} , r_{TB} , and r_{CL} . For individual investors, time deposits and long-term government bonds have similar risk characteristics; therefore, an increase in r_{MAX} will cause investors to shift their portfolio composition away from government bonds causing r_{GB} to increase. The positive sign on r_{TB} indicates the existence of a positive yield curve, and the positive sign on r_{CB} indicates that corporate bonds substitute for government bonds in the portfolios of many investors.

The interest rate on agency bonds is negatively related to the total demand for agency bonds by all investors and positively related to the prime lending rate and the long-term interest rate on government bonds. Agency securities are often perceived to be backed by the full faith and credit of the U.S. government. Although technically that is not true, it is debatable whether or not the government would allow any federal agencies to default on their securities. As expected, the interest rate on agency bonds closely follows the interest rate on long-term government securities. Sponsored credit agencies in the Federal Reserve flow-of-funds data include Federal Land Bank (FLB), Federal Intermediate Credit Bank, Bank for Cooperatives, Federal National Mortgage Association, Federal Home Loan Bank, Government National Mortgage Association, Federal Home Loan Mortgage Corporation, and Student Loan Marketing Association. The securities issued by those agencies are primarily backed by mortgages; therefore, r_{CL} and r_{AB} are positively related. All variables are significant at the 1 percent level.

The prime lending rate is related to supply through *EXRES* (a measure of the loanable funds available to depository and other

financial institutions). The negative sign on that variable indicates that an increase in loanable funds, through increases either in deposits or borrowed reserves or decreases in security holdings or outstanding loans, decreases the prime lending rate. The prime rate is positively related to the Federal Reserve discount rate. An increase in the discount rate represents an increase in the cost of being caught short of reserves. This would make lenders more cautious in their lending decisions and decrease the supply of loans, increasing the prime rate. The prime rate is positively related to the interest rate on short-term government securities due to the trade-off between loans or securities held in the portfolios of depository institutions. All variables are significant at less than the 5 percent level.

Two agricultural interest rates are determined in an equilibrium framework in this section of the model. They are nonreal estate and real estate interest rates on funds borrowed from Production Credit Associations (PCA) and FLB, respectively, which together comprises FCS. Prior to 1980, FmHA rates were fixed for long periods of time and were only occasionally adjusted according to the cost of funds to the government. For that reason the interest rate on FmHA loans is assumed to be set exogenously. Because agriculture is such a small part of the total loan market, it is also assumed that agriculture has no effect on the interest rates charged by commercial banks. Therefore, the interest rate charged for agricultural funds loaned by commercial banks is determined by the bank reserves market and portfolio adjustments to changes in other interest rates. The correlation between r_{CL} and the loan rate charged by commercial banks on agricultural loans between 1977 and 1986 is .9029, indicating that r_{CL} is a good proxy for the commercial bank agricultural loan rate that is unavailable for the entire estimation time period used in this study.

The interest rates on PCA and FLB loans are positively related to the rate on agency bonds. An increase in the cost of issuing bonds for FCS, as represented by an increase in r_{AB} , will increase r_{PCA} and r_{FLB} because PCA and FLB base their interest rates on the average interest cost on outstanding agency bonds issued to fund their loans. The interest

rate on PCA loans is positively related to the prime lending rate and negatively related to the total demand for farm debt outside the FCS indicating that debt from FCS substitutes for debt from other agricultural lenders. The interest rate on FLB debt is negatively related to r_{CL} . Because FLB is the primary real estate lender and commercial banks are the primary nonreal estate lender in agriculture, the interest rate relationship could be a reflection of the fact that increases in real estate holdings generally require additional nonreal estate debt to finance increased machinery and/or operating expenses for the new, larger operation. The lagged dependent variable is included in the r_{FLB} equation because over the time period used for the estimation FLB rates were fairly stable (between 1970 and 1978 nominal quarterly interest rates vary only 1.43 percent). All variables are significant at less than the 1 percent level.

Simulation

The entire model is simulated in a dynamic, linear, deterministic framework. That will limit the presence of autocorrelation resulting from excluded variables, as factors influencing one variable are allowed to indirectly influence other endogenous variables. There is much debate concerning the appropriate way to test the validity of a model. Comparing ex post projections to actual observations is one of the most rigorous tests.

Actual and ex post values for Theil's inequality coefficient are reported in Table 2. Theil proposed the $U1$ statistic to overcome one of the limitations of the U statistic, namely, that it is sensitive to an additive transformation and, therefore, comparisons across models are misleading. The $U1$ statistic, like the U statistic, is bounded by zero and one, with zero indicating a perfect simulation. The $U1$ statistics (Table 2) indicate that interest rates modeled from a structural perspective track fairly well over the sample period and that the projections are, on the whole, reasonable.

Policy Scenarios

An exogenous shock in the form of a 10 percent increase in the real budget deficit was applied to the system in 1981. The

estimation time period ended in 1980; therefore, the increase does not alter the parameter estimates but does affect the solution values for the endogenous variables. The one period shock implies that the government would be able to prevent continued increases in the real budget deficit. Because the focus of the model is on interest rates, only results for those equations are reported.

An increase in the deficit causes a one-to-one increase in the variable $DDMBFOR$, which is an independent variable in the r_{GB} equation. Any increases in r_{GB} are transmitted to other financial assets and debts through the portfolio balance framework captured in the model.

The comparison of the forecast for various endogenous interest rates under the increased real budget deficit scenario with the baseline forecast is reported in Table 3. A 10 percent increase in the deficit increases r_{GB} , r_{AB} , r_{CL} , r_{PCA} , and r_{FLB} , by 7, 6, 2, 6, and 9 basis points, respectively. The numbers reported in column five represent the effect of a 10 percent increase in an exogenous variable on an endogenous variable.

Because the results are reported as percentage changes from the baseline forecast they can be interpreted as elasticities once allowance is made for the fact that the shock is a 10 percent rather than a 1 percent increase in the exogenous variable. The values presented indicate the inelastic response of interest rates to changes in the federal budget deficit. That is consistent with the work of Roley and Feldstein and Eckstein. The elasticities with respect to a change in the deficit for r_{PCA} and r_{FLB} are .11 and .31, while the elasticity for r_{CL} is only .02. Nonfarm interest rates are much less responsive to changes in the federal budget deficit than interest rates in the agricultural sector. Those values represent only the elasticity for the year in which the change was simulated not the average effect over the simulation time period. It appears reasonable, however, to assume the response would be similar for 1982 and 1983.

One possible explanation for the increased sensitivity of agricultural interest rates to changes in the federal budget deficit is the pricing system used by FCS. Both PCA and

Table 3. Effects of Shocks to the System on Selected Real Interest Rates

Variable	Year	Baseline Forecast ¹	Projections With Public Financing of an Increased Deficit ¹	Projections With Monetization of an Increased Deficit ¹	10% Increase in Deficit ²	Monetization of Deficit ³
r_{GB}	1981	4.41	4.48	4.42	.75	-1.44
	1982	7.81	7.82	7.87	.11	.61
	1983	9.21	9.22	9.22	.11	.04
r_{AB}	1981	5.89	5.95	5.9	1.1	-.92
	1982	5.89	8.9	8.94	.09	.45
	1983	10.05	10.06	10.07	.09	.03
r_{CL}	1981	6.73	6.75	6.73	.16	-.15
	1982	7.45	7.45	7.46	.03	.11
	1983	7.31	7.31	7.31	.04	-.01
r_{PCA}	1981	5.72	5.78	5.73	1.06	-.88
	1982	8.3	8.31	8.35	.15	.41
	1983	8.9	8.91	8.91	.17	.01
r_{FLB}	1981	4.19	4.28	4.21	3.06	-1.69
	1982	8.49	8.51	8.55	.29	.47
	1983	10.95	10.97	10.98	.14	.11

¹Interest rate levels are reported in percents.

²Numbers reported represent the percentage change from the baseline forecast.

³Numbers represent the percentage change from the projections with an increase in the deficit.

FLB interest rates are firmly tied to the cost of their loanable funds—the interest rates on agency bonds. Those securities are perceived to be only slightly more risky than government bonds, making agency bonds close substitutes for government bonds in the portfolios of investors. Therefore, changes in r_{AB} closely follow changes in r_{GB} and are quickly translated into changes in r_{FLB} and r_{PCA} .

The prime rate in this model is also determined in part by the supply of loanable funds as captured by the variable $EXRES$. The variable is unaffected by changes in the deficit. It is only through changes in r_{TB} , a measure of the opportunity cost of making loans (because banks could always choose to purchase securities instead of making loans) that deficits have an impact on r_{CL} . Therefore, the rigid pricing system of FCS causes farm sector interest rates to be more responsive to changes in the federal deficit than nonfarm interest rates.

The effect of a monetization of the budget deficit by the Federal Reserve is presented in column six. Monetization of the deficit is accomplished through an increase in nonborrowed reserves equal to the increase in the deficit. The increase in the money supply does not completely counteract the impact of the budget deficit. Although the impact of the increase in nonborrowed reserves cancels out the increase in the deficit, nonborrowed reserves also affect borrowed reserves, so an increase in nonborrowed reserves translates into a smaller increase in the money supply.

If nonborrowed reserves are increased to compensate for the increased federal budget deficit, interest rates fall in relation to projections that assume public financing of the deficit. The decrease in interest rates causes farm debt to increase, but again, not back to baseline levels.

This simulation indicates that an increase in the deficit raises interest rates in the current year. The Federal Reserve can counteract some, but not all, of the crowding out effects caused by financing the federal deficit. The impact of those changes is felt throughout the time period simulated as the endogenous variables adjust to their new long-run values.

Conclusions

The results of the policy simulation indicate that a 10 percent increase in the real budget deficit will increase all interest rates in the economy. A liberal monetary policy combined with a liberal fiscal policy partially compensates for the effects of the budget deficit. Interest rates are found to return to values close to the baseline scenario.

Between 1982 and 1983 the budget deficit increased 123 percent, implying that the effects seen in the simulation would be multiplied by twelve. Real short-term interest rates in the agricultural sector would rise 74 basis points; real long-term rates would rise 111 basis points while real interest rates in the nonfarm sector would increase only 25 basis points. Interest rates in the agricultural sector prove to be more responsive to changes in the federal budget deficit, implying that agricultural producers are being asked to shoulder a disproportionate share of the adverse impact of deficit financing.

The increase in the deficit occurred at a time when other macroeconomic policies were causing a decline in farm prices and land values. All agricultural lenders have felt the impact of the changing economic climate in agriculture. Proposed funding for agricultural credit from the government is at its lowest level in many years at a time when commercial banks and the FCS are trying to reduce their exposure in that high risk sector. This analysis suggests that current macroeconomic policy will lead to further increases in the cost of agricultural credit and indicates that higher real budget deficits put more pressure on interest rates in the agricultural sector than on other sectors of the economy.

References

- Backus, David, William C. Brainard, Gary Smith, and James Tobin. "A Model of U.S. Financial and Nonfinancial Behavior." *J. of Money, Credit and Banking* 12 (1980):259-93.
- Challen, D.W., and A.J. Hagger, *Macroeconometric Systems Construction, Validation, and Applications*. New York: St. Martin's Press, 1983.
- Evans, Paul. "Do Large Deficits Product High Interest Rates?" *Amer. Econ. Rev.* 75(1985):68-87.
- Evans, Paul. "Interest Rates and Expected Future Budget Deficits in the United States." *J. of Po. Econ.* 95(1987):34-58.
- Feldstein, Martin S., and Otto Eckstein. "The Fundamental Determinants of the Interest Rate." *Rev. of Econ. and Stat.* 52(1970):363-75.
- Friedman, Benjamin M. "Interest Rate Implications for Fiscal and Monetary Policies: A Postscript on the Government Budget Constraint." *J. of Money, Credit, and Banking* 14(1982):407-12.
- Hoelscher, Gregory P. "Federal Borrowing and Short-Term Interest Rates." *S. J. of Econ.* 50(1983):319-33.
- Howrey, E. P., L. R. Klein, M.D. McCarthy, and G. R. Schink. "The Parities of Macroeconometric Model Building and Its Rationale." *Large-Scale Macroeconometric Models*. New York: North-Holland Publishing Co., 1981.
- Hutchison, Michael M., and David H. Pyle. "The Real Interest Rate/Budget Deficit Link: International Evidence, 1972-82." *Economic Review* Federal Reserve Bank of San Francisco 4(1984):26-35.
- Lemieux, Catharine M. "Capital Markets in Agriculture: A Disaggregated Structural Model." Ph.D. diss., Texas A & M University, 1985.
- Mishkin, Frederic S. "Efficient Market Theory: Implications for Monetary Policy." *Brookings Papers on Economic Activity* 3(1978):707-52.
- Motley, Brian. "Real Interest Rates, Money, and Government Deficits." *Economic Review* Federal Reserve Bank of San Francisco 3(1983):31-45.
- Muth, J.F. "Rational Expectations and the Theory of Price Movements." *Econometrica* 29(1961):315-35.

Penson, John B., Jr. "Demand for Financial Assets in the Farm Sector: A Portfolio Balance Approach." *Amer. J. Agr. Econ.* 54(1972):163-74.

Roley, V. Vance. "The Determinants of the Treasury Security Yield Curve." *J. of Fin.* 36(1981):1103-26.

Silber, William L. *Portfolio Behavior of Financial Institutions*. New York: Holt, Rinehart, and Winston, 1970.

Sinai, Allen, and Peter Rathjens. "Deficits, Interest Rates, and the Economy." *Data Resources U.S. Review*, June 1983, 1.27-1.41.

Theil, Henri. *Economic Forecasts and Policy*. Amsterdam: North-Holland Publishing Co., 1961.

Thompson, Robert L. "Domestic Fiscal Policy Linkages to Agriculture." Paper presented at the American Agricultural Economics Association annual meeting, Reno, Nevada, July 1986.

U.S. Department of Agriculture, Economic Research Service. *Financial Characteristics of U.S. Farms, January 1, 1986*. AIB 500. Washington, D.C., 1986.

Agricultural Assets in an Efficient Multiperiod Investment Portfolio

Charles B. Moss, Allen M. Featherstone, and Timothy G. Baker

Abstract

The risk-return attractiveness of farm assets is investigated using a quadratic programming model with opportunities to invest in farm and nonfarm assets. The model incorporates a multiple-year planning horizon and captures correlations among asset returns over time by using an autoregressive expectations model. Agricultural assets enter the EV efficient portfolios estimated in this study at relatively high levels, implying that agricultural assets may have been underpriced relative to their risk and that nonfarm investors may gain from including farm assets in their portfolios.

Key words: farm assets, investment portfolios, nonfarm investors, multiperiod EV model, intertemporal risk.

A critical problem facing some farmers today involves the inability to raise debt capital. A related issue is the decline in asset values since 1981, which has eroded farmers' equity capital. For some farmers the debt-to-equity ratio has become so unfavorable that major portfolio adjustments, such as selling assets to reduce debt or acquiring direct equity investment from partners or stockholders, are needed. Nonfarm investment in agriculture would provide equity capital and might improve liquidity in markets for agricultural assets.

Investors are not likely to put capital into agriculture merely for the public good. However, investors may choose to include agricultural assets in their portfolios if agricultural assets have attractive risk-return characteristics. Such a diversifying strategy could benefit both farmers and nonfarm investors.

The paper's purpose is to determine the extent to which agricultural assets enter risk-efficient investment portfolios for investors who have stocks, bonds, Treasury bills, and farm assets as investment alternatives. To accomplish this purpose the study develops a method to model multiple-year investment planning horizons. The empirical results should be of interest to those involved in developing new institutions, new financial instruments, and agricultural policies to deal with the financial crisis, as well as to farmers, nonfarm investors, realtors, and investment advisers.

One unique aspect of the study is the examination of portfolios for investors that have multiple-year planning horizons. When returns for some assets are not independent over time it is important for investors to consider intertemporal risk in portfolio decision making. Thus, this study will examine the attractiveness of farm assets in

Charles B. Moss is an assistant professor in the Food and Resource Economics Department, University of Florida. Tim Baker is an associate professor in the Department of Agricultural Economics, Purdue University. Allen M. Featherstone is an assistant professor, Department of Agricultural Economics, Kansas State University. The authors would like to acknowledge the helpful suggestions of Calum Turvey.

Partial funding for the research was provided by the Economic Indicators and Statistics Branch of the National Economics Division, Economic Research Service, U.S. Department of Agriculture. This paper represents the authors' views and not necessarily those of the USDA.

multiple time period models as well as in the traditional single period model. Also, unlike many studies that assume the investor can borrow or invest at a risk-free rate, this study uses real rates of return and recognizes that real borrowing and saving rates are not riskless or equal.

The next section of this paper discusses portfolio selection theory. The procedure section, which includes criteria to determine the efficient investment portfolio, follows. Results of the empirical analysis are then presented, followed by conclusions from the research.

Methods

The primary theoretical basis for risky decision making is the expected utility hypothesis (EUH). From the EUH, it is deduced that decision makers select portfolios that maximize their expected utility. Researchers are often able to perform useful analysis without literal application of the EUH by using efficiency criteria. Efficiency criteria are methods of analysis that reduce the set of all possible actions to a smaller set of actions that includes the expected utility maximizing action.

It is well known that the EV (expected value-variance) method is an efficiency criterion if returns have a normal probability distribution or if the decision maker's utility function is quadratic. EV is often criticized, because the assumptions are thought to be implausible or violated empirically. However, several studies, including Levy and Markowitz, and Kroll, Levy, and Markowitz, have found that the EV approach is quite robust to violations of the assumptions.

This study uses the EV method to generate a set of risk efficient investment portfolios. Specifically, investment portfolios in a multiperiod context are chosen such that

$$\max_X z = C'X - \theta X' \Omega X \quad (1)$$

Subject to

$$\sum_j x_{1j} = 100 \quad (2)$$

$$x_{1j} = x_{2j} = \dots = x_{nj}, \text{ for each } j \quad (3)$$

where the choice variable is an $n(m) \times 1$ vector of asset percentages, n is the number of holding periods, and m is the number of alternative investment assets.¹ The variable C is a $n(m) \times 1$ vector of expected continuous time rates of return, θ is a measure of relative risk aversion and Ω is an $nm \times nm$ matrix of variances of rate of return and covariances.²

Equation 2 requires that investment percentages sum to 100 percent of equity. Short sales are limited to borrowing activity.

The amount invested in each asset is constant throughout the planning horizon, equation 3. It assumes that investors have a buy and hold strategy, and it is realistic for a portfolio containing farm assets.

When rates of return are in continuous time measurement, maximization of the sum of returns over years maximizes ending wealth. That can be seen as follows

$$W_T = W_0 \prod_{i=1}^T \exp(r_i) = W_0 \exp\left(\sum_{i=1}^T r_i\right) \quad (4)$$

where W_T is wealth after T years, W_0 is initial wealth, and r_i is the rate of return in year i . Maximizing the exponentiated sum will maximize W_T . Thus, the correspondence between wealth and the sum of returns motivates the use in this study of continuous time units and simple summation over years.

To apply the EV criteria the mean returns (vector C) and variances and covariances (Ω) must be estimated. An estimation process and information set that are consistent with investors' subjective beliefs should be chosen.

¹The vector $X = (x_{11}, x_{12}, \dots, x_{1m}, x_{21}, \dots, x_{2m}, \dots, x_{n1}, \dots, x_{nm})$.

²Pulley employed a Taylor-series approximation of expected utility to derive a mean-variance model in rate of return. In his model the risk aversion coefficient is one-half of the Pratt-Arrow coefficient of relative risk aversion evaluated at a zero rate of return. A zero rate of return implies that the relative risk aversion coefficient is evaluated at the beginning of period wealth. Collins (p. 628) has shown the identical result for the negative exponential utility function without approximation when rates of return are distributed normally.

The model in this study is formulated in real rates of return to avoid implicitly assuming money illusion. No risk-free asset is assumed, thus, the separation theorem (Johnson, Tobin) is not applied in this study. After estimating the parameters for the EV model, risk-efficient portfolios are generated by varying the risk aversion parameter. The risk-efficient portfolios are then examined to determine if investors would gain from investing in agricultural assets.

Procedure for Estimating Parameters

When using sample data to estimate means and variances for EV analysis, it is often assumed that the sample observations are independently and identically distributed. However, it is quite common in economic time series data for observations of returns to be related across time. If investment returns are correlated across time, then the simple estimate of the sample variance does not use all of the information contained in the sample. Use of the sample variance, therefore, assumes that investors do not use all of the information available. Failing to use the information that decision makers with rational expectations use would result in inappropriate estimates of the contemporaneous variances and covariances.

The procedure used to estimate the variance-covariance relationship focuses on assumptions about decision makers' expectation processes. The following section develops the procedure used to estimate the variance-covariance matrix. The single asset multiple time period case is described first, then an extension is made to the multiple asset case.

We assume that the decision maker's expectations of returns follow an autoregressive process. That assumption permits the model of expectations to capture the correlation of returns over time, which is an important factor in a multiple-year portfolio model. The focus in this section is on the variance and covariance of returns, thus, it is convenient to focus on the stochastic process of errors (deviations from the mean). The current error is assumed to be a function of past errors and a white noise component (u_t). A first order model of a one variable system is described in equation 5 by the error in the last time

period (e_{t-1}) multiplied by the autocorrelation coefficient (ρ) and a random variable u_t .

$$e_t = \rho e_{t-1} + u_t \quad (5)$$

By assumption, the white noise component is not correlated with the past error or the white noise component of the past error. That is

$$\begin{aligned} E[e_{t-1} u_t] &= 0, \\ E[u_t u_{t-i}] &= 0, \text{ for all } i \end{aligned} \quad (6)$$

Once the form of the model has been specified for each future time period, construction of the variance-covariance matrix proceeds according to the statistical definitions of variance and covariance.

If time t is considered to be some general starting period, rather than a specific year, the expected error (zero) for last period can be used. With that assumption the expected return for each future period is the same and is equal to the sample mean. Also, in this case the errors from equation 5 for each year of an n year investment period can be written as follows

$$\begin{aligned} e_t &= u_t \\ e_{t+1} &= \rho u_t + u_{t+1} \\ e_{t+2} &= \rho^2 u_t + \rho u_{t+1} + u_{t+2} \\ &\vdots \\ e_{t+n-1} &= \rho^{n-1} u_t + \rho^{n-2} u_{t+1} + \dots + u_{t+n-1} \end{aligned} \quad (7)$$

Because the expected value of u is zero, the expected value of the total error in any period is zero. The variance of returns for each period is derived in equation 8 from the relationships defined in equation 7.

$$\begin{aligned} V[e_t] &= \sigma_u^2 \\ V[e_{t+1}] &= (1 + \rho^2) \sigma_u^2 \\ &\vdots \\ V[e_{t+n-1}] &= \left(\sum_{i=1}^n \rho^{2(n-i)} \right) \sigma_u^2 \end{aligned} \quad (8)$$

These values give their own variances for a given investment for each year of a multiple-year holding period assuming a first order autoregressive model. The covariances

between periods can also be derived by the application of statistical definitions. The covariance of two random variables x and y is defined as

$$\text{Cov}(x, y) = E[xy] - E[x]E[y] \quad (9)$$

Using the definition in equation 9, and the assumptions that the random component of the errors (u_i) across periods are independent, in conjunction with the condition that expected future errors are zero, the covariance between returns in the first time period and returns in future periods are

$$\begin{aligned} \text{Cov}(e_t, e_{t+1}) &= \rho \sigma_u^2 \\ \text{Cov}(e_t, e_{t+2}) &= \rho^2 \sigma_u^2 \\ &\vdots \\ \text{Cov}(e_t, e_{t+n}) &= \rho^n \sigma_u^2 \end{aligned} \quad (10)$$

The covariances between returns in the second time period and periods beyond are

$$\begin{aligned} \text{Cov}(e_{t+1}, e_{t+2}) &= \rho(1 + \rho^2) \sigma_u^2 \\ \text{Cov}(e_{t+1}, e_{t+3}) &= \rho^2(1 + \rho^2) \sigma_u^2 \\ &\vdots \\ \text{Cov}(e_{t+1}, e_{t+n}) &= \rho^{n-1}(1 + \rho^2) \sigma_u^2 \end{aligned} \quad (11)$$

The lower half and diagonal elements of the variance-covariance matrix of returns for a single asset over n future years is shown in the box.

The mathematical extension of the single asset multiple time period case to the multiple asset case is given in the appendix.

The Multiple Asset Multiple Holding Period Model

The expected returns and variance of returns for an EV model with a multiple-year planning horizon are given in this section. It is also shown that the multiple-year and single-year models give identical portfolios when there is no autocorrelation of returns.

The mean return over the n -year holding period is given by equation 12. The expected rates of return are simply summed across years, as well as across assets, because the rates are in continuous time units.

$$C^*X = \sum_{i=1}^n \sum_{j=1}^m c_{ij} x_{ij} \quad (12)$$

where c_{ij} and x_{ij} are elements in C and X , respectively, n is the number of years, and m is the number of assets.

If the expected rate of return for each asset is constant across years, then the expected multiple period return is simply n times the single period return, shown as equation 13.

$$C^*X = n \sum_{j=1}^m c_j x_j \quad (13)$$

$$\sigma_u^2 = \begin{bmatrix} 1 & & & & \\ \rho & (1+\rho^2) & & & \\ \rho^2 & \rho(1+\rho^2) & (1+\rho^2+\rho^4) & & \\ \rho^3 & \rho^2(1+\rho^2) & \rho(1+\rho^2+\rho^4) & (1+\rho^2+\rho^4+\rho^6) & \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ \rho^n & \rho^{n-1}(1+\rho^2) & \rho^{n-2}(1+\rho^2+\rho^4) & \rho^{n-3}(1+\rho^2+\rho^4+\rho^6) & \dots (1+\rho^2+\dots+\rho^{2n}) \end{bmatrix}$$

The variance of the multiple-year return is written in equation 14 using summation notation.

$$X' \Omega X = \left\{ \sum_{j=1}^n \left[\sum_{i=1}^m x_{ij}^2 \text{Var}(x_{ij}) + \sum_{\substack{j=1 \\ j \neq k}}^m \sum_{k=1}^m x_{ij} x_{ik} \text{Cov}(x_{ij}, x_{ik}) \right] \right\} + \sum_{j=1}^m \sum_{i=1}^n \sum_{h=1}^n x_{ij} x_{ih} \text{Cov}(x_{ij}, x_{ih}) \quad (14)$$

The variance of returns is shown above as the sum of two major parts. In the first part, the within-year variances and covariances are weighted by amounts of each of the m assets held and then summed across the n years. The second term sums the weighted across-year covariance terms.

The relationship between the multiple period model used in this study and the traditional single period model is seen by studying simplifications of equation 14. If returns for all assets are independent across years, then all of the covariances across years are zero, and the whole second term becomes zero. Additionally, if the contemporaneous variances and covariances are the same for each year then the first term becomes n times the variance for one year.

Thus, if there is no correlation among returns across years and if the within-year variance-covariance matrix is the same for each year, then the variance of total returns is

$$X' \Omega X = n \left\{ \sum_{j=1}^m x_j^2 \text{Var}(x_j) + \sum_{\substack{j=1 \\ j \neq k}}^m \sum_{k=1}^m x_j x_k \text{Cov}(x_j, x_k) \right\} \quad (15)$$

If the mean returns are the same for all years and if the correlations across years are zero, then the expected return given by equation 13 and the variance of returns given by equation 15 would be used in the EV objective function. In this case dividing the objective functions by n , the number of years in the planning horizon, would simplify the problem into the conventional single-year portfolio model. However, because zero autocorrelation of return is not assumed in this study, the EV model employed will use equation 14 for the variance of multiple-year returns.

Data

Real returns from eight investment alternatives are considered in this study: common stocks, small capitalization stocks, long-term corporate bonds, long-term U.S. government bonds, U.S. Treasury bills, money, borrowing at the prime interest rate, and farm assets. Data from 1926 through 1984 for all series except farm assets, prime interest rate, and money are from Ibbotson Associates. Data for farm assets and money are from Melichar (1984a). The prime interest rate data are from the Board of Governors of the Federal Reserve System (1976 and 1943).

Common stock returns are based upon the *Standard and Poor's Composite Index*, which currently includes 500 of the largest companies in the U.S. Capital appreciation and dividends are included in the returns. Small stock returns are based on the capital appreciation and dividends of the smallest 20 percent of companies whose stocks are traded on the New York Stock Exchange. Since 1982, the small stock data includes companies of similar size on the Amex. Long-term corporate bond returns include coupon payments (interest) and appreciation and are based on the *Salomon Brothers High-Grade Long-Term Corporate Bond Index*. Long-term U.S. government bonds are based upon the returns, including appreciation, of bonds with a maturity near twenty years. U.S. Treasury bill returns are one-month holding period returns for the shortest-term bills not less than one month in maturity. More detail on those data series can be found in Ibbotson Associates.

Returns to farm assets are the sum of Melichar's (1984a) income from assets and capital gains. The data are for the aggregate farm sector excluding farm households. More details on the calculation of income from assets are in Melichar (1984b).

The personal consumption expenditures portion of the implicit GNP deflator (PCE) is used to determine the inflation rate that was used in deflating all return series. All of the data were converted from effective annual (compound annual) into continuous time by taking the natural logarithm of one plus the effective annual rate. Thus, the calculation of real returns simply requires subtraction of

the inflation rate from the nominal rate of return. The real return to money in this study is the negative of the inflation rate.

Aggregate data for stock returns reflect the stock market opportunities for well-diversified investors. In essence the stock market series reflect only the broad systematic movements in the stock market with the independent return variations of individual stocks diversified away or averaged out. Many studies have found that strategies of picking and trading stocks in an attempt to beat the market do not on average return enough extra profit to pay the transaction costs. (For a review see Malkiel.)

The farm sector data are similar in that the risk specific to individual assets within the sector is diversified away and only the systematic farm sector risk remains in the data. Unlike the stock, bond, and bill returns, which are rather readily achievable by investors through investment in widely available mutual funds, investment in a share of farm sector assets is not widely available. The investments that are potentially available (such as investing directly into individual farms, buying stock in the few agricultural companies publicly traded, limited partnerships, or diversifying across those choices) would have greater risk. The

probable underestimation of risk is handled by generating portfolios with the farm asset return variance increased. Portfolios estimated using the aggregate farm sector data investigate the question of whether or not the systematic risk within the farm and nonfarm sectors can potentially be reduced by diversifying across sectors (Barry)

Empirical Estimates of the Expectations Model

The expectations process was assumed in this study to be a multivariate first-order autoregressive model. An equation for each asset's rate of return was estimated as a function of all assets previous year's returns using ordinary least squares. The regression results are in Table 1. The log-likelihood test (suggested by Sims) for the first order model is statistically significant at the 1 percent level. Thus, the data indicate strong evidence against the null hypothesis that real returns for the investments in this study are uncorrelated over time. The first order model contains information that an investor with rational expectations would use. On that basis it is a better representation of decision maker expectations than sample moments. It suggests that a single-year model would not be an accurate representation for a decision maker with a multiple-year planning horizon.

Table 1. Regression Coefficients and Statistics for Asset Rate of Returns Equations

Variables	Intercept	Variables Lagged One Period								R ²	F Value
		Corp. Bonds	Corp. Stock	Farm Assets	Govt. Bonds	Money	Prime Interest	Small Stocks	Treas. Bills		
(Corp. Bonds) _t	.00965 (.03465)	.1853 (.3461)	.0637 (.0998)	-.4622 (.2603)	-.2537 (.3444)	.3117 (.4308)	2.2047 (1.9763)	-.0695 (.0629)	-1.9785 (2.1975)	36.24	3.481*
(Corp. Stock) _t	.10905 (.09956)	-.62799 (.9944)	.0071 (.2866)	-.7716 (.7478)	1.1894 (.9893)	-.4282 (1.2375)	-1.58104 (5.6775)	.013156 (.1806)	.80577 (6.3129)	8.99	.605
(Farm Assets) _t	.06293* (.02025)	-.32058 (.20225)	-.07753 (.0583)	.2856 (.1521)	.5929* (.20122)	-.05495 (.2517)	-1.8937 (1.1548)	.05492 (.036735)	1.2571 (1.283998)	55.90	7.765*
(Govt. Bonds) _t	.00499 (.03462)	.4498 (.3458)	.05806 (.0997)	-.35099 (.26005)	-.6185 (.344039)	.3428 (.4303)	1.724 (1.9743)	-.0759 (.0628)	-1.3928 (2.1953)	33.61	3.101*
(Money) _t	-.00665 (.01162)	.1731 (.1160)	.0558 (.0334)	-.0835 (.0873)	-.1981 (.1155)	.6512* (.1444)	.0042 (.6625)	-.0573* (.0211)	-.0009 (.7367)	69.00	13.636*
(Prime Interest) _t	-.00357 (.01071)	.1504 (.1070)	.0576 (.0308)	-.0017 (.0805)	-.2566* (.1065)	-.3047* (.1332)	.7036 (.6110)	-.0525* (.0194)	.3843 (.6793)	79.41	23.693*
(Small Stocks) _t	.02103 (.15378)	-.5028 (1.5360)	-.7901 (.4426)	.1562 (1.1551)	1.6513 (1.5282)	-.3630 (1.9115)	3.3199 (8.7699)	.4874 (.2790)	-4.2878 (9.7514)	14.29	1.021
(T-Bills) _t	-.00902 (.01052)	.1811 (.1051)	.0618* (.0303)	-.0195 (.0790)	-.2714* (.1045)	-.2670* (.1307)	.1253 (.5998)	-.0497* (.0191)	.8807 (.6669)	76.85	20.338*

*Indicates that the coefficients are different from zero at the 5 percent level of statistical significance. Coefficient standard deviations are in parentheses.

The equations for common stocks and small stocks have F statistics that are not significant. In this case, past returns are not statistically significant predictors of future returns. The result is consistent with studies indicating that the stock market is information efficient, and perhaps, suggests that if one is studying only a stock portfolio a single-period model may be adequate.

The mean and standard deviation of one-year holding period rates of return are given in Table 2 for each of the investment alternatives, and the contemporaneous correlation matrix for the alternatives are given in Table 3. The data in the tables are based upon the expectation model estimated. The mean rates of returns are based upon taking expected values of the dependent

variables with past errors set to zero. That assumes steady state initial conditions. The contemporaneous correlation matrix and standard errors are from the variance-covariance matrix of the regression residuals.

For multiple-year models the expected rates of return all years are the same because of the steady state initial conditions. Appendix equation A.9 is used to calculate coefficients for the variance-covariance matrix for multiple-year models. Calculation of the multiple-year variance-covariance coefficients uses the matrix of regression coefficients and the regression error variance-covariance matrix (see the appendix for greater detail).

The expected rate of return on farm assets over the 1926 to 1984 period of 4.65 percent is more than the rate of return on corporate and government debt but less than the rate of return on common stocks (6.01 percent) and small stocks (8.64 percent). However, the stock returns are more variable. The expected returns and standard deviations generally follow a pattern of increasing expected returns associated with increasing standard deviation. The exceptions to that rule are money and government bonds. Those investments are dominated in a pairwise manner (other investments offer a larger return for the same or smaller variance). That dominance does not rule them out of the optimal portfolio because it

Table 2. Continuous Time Mean and Standard Deviations of One-Year Investment Real Rates of Return (Percent)

	Mean	Std. Dev.
Corp. Bonds	1.24	6.71
Common Stocks	6.01	19.29
Farm Assets	4.65	3.87
Government Bonds	.55	6.71
Money	-3.06	7.14
Prime Interest	1.81	20.74
Small Stocks	8.64	29.83
Treasury Bills	.22	2.00

Table 3. Contemporaneous Correlations Among Real Rates of Return for Alternative Investments

	Corp. Bonds	Common Stocks	Farm Assets	Gov. Bonds	Money	Prime Int.	Small Stocks	T-Bills
Corp. Bonds	1	.1899	-.0106	.9225	.4487	.1671	.0654	.1833
Common Stocks		1	.2208	.1426	.0723	.0026	.8711	-.0017
Farm Assets			1	-.1023	-.2204	-.2053	.1443	-.1608
Government Bonds				1	.4005	.1568	.0296	.1654
Money					1	.9041	-.0896	.9085
Prime Interest						1	-.1612	.9807
Small Stocks							1	-.1828
T-Bills								1

does not take into account the covariance among assets.

The contemporaneous correlation matrix provides insight into the combinations of assets that may occur. Money has a negative expected real return so it is not a desirable investment by itself. However, the return on money is negatively correlated with farm asset and small stock returns. Because of the negative correlation, portfolios containing large shares of farm assets and small stocks may also contain money to reduce the variance.

The estimates of the contemporaneous correlations are not far from estimates used in past studies (Ibbotson and Fall). Real returns to farm assets are negatively correlated with those of corporate bonds, government bonds, money, prime interest rates, and Treasury bills. Farm asset returns are positively correlated with common and small stock returns. The strongest positive correlation in our data is between the real prime interest rate and real Treasury bill rates, the strongest negative correlation is between farm assets and money.

Portfolio Results

This section discusses the portfolio choices for one-, five-, and ten-year planning horizons and portfolios with the original and quadrupled variance of agricultural returns.

To provide a benchmark for the level of agricultural assets in the efficient portfolio, the percentage that agricultural assets are of total assets in the U.S. is needed.³ Ibbotson and Fall list the percent of farm real estate in the capital markets for the period 1947 to 1978. Farm real estate in that market is given as 9.34 to 14.22 percent. Ibbotson and Fall's capital market portfolio includes residential real estate. When the amount of residential real estate held in each of the periods is removed, farm real estate is 13.91 to 21.62

percent over the period 1947 to 1978. That range provides a benchmark for comparison with the portfolios reported below.

EV efficient portfolios over a range of risk aversion coefficients are shown in Table 4 for one-, five-, and ten-year planning horizons. Risk aversion was reduced until leverage portfolios were chosen, but portfolios with more than two-thirds debt to asset are not presented. The estimated portfolios contain a larger percentage farm assets than the historical 14 to 22 percent share of total capital that farm assets have been. That result holds over alternative levels of risk aversion and over all three holding periods (Figure 1). The horizontal axis in Figure 1 is not drawn to scale, it is simply one increment for each risk aversion coefficient. Levels of risk aversion shown in the figure extend beyond those shown in the table.

For the five- and ten-year planning horizons the level of farm assets in the portfolio is fairly constant across risk aversion levels. The percentage of farm assets in the portfolio is less for longer planning horizons for the less risk averse investors (Figure 1). The portfolios are highly leveraged (Table 4). On the other hand, the level of farm assets is greater for the longer planning horizons for the more risk averse investors.

The results suggest that farm assets may have been undervalued in light of their risk-return relationship. The results also indicate that the historical risk-return relationship of farm assets make them attractive portfolio investments for nonfarm investors. Barry studied farm real estate aggregated to the state and national levels using the CAPM approach and reached similar conclusions. His data cover the interval 1950 to 1977. Our results indicate that farm assets should be attractive to nonfarm investors even when the data period is expanded to include the less favorable 1930s and 1980s.

To examine the sensitivity of the results to the level of variance of returns to farm assets the model was reformulated multiplying the variance of farm assets by four, keeping all other variances and all correlations constant. As expected, the percentage of the portfolio in farm assets declines for comparable levels of risk aversion. However, results for the five-

³If the market is in equilibrium and if the EV model in this study is an accurate description of the market, then the capital asset pricing model (Lintner, Sharpe) suggests that farm assets should be in the portfolio in the same percentage that farm assets are of the market portfolio. If farm assets are in the portfolio in a smaller percentage they are overpriced for their degree of systematic risk and vice versa.

Table 4. Optimal Portfolios For One-, Five-, and Ten-Year Holding Periods at Selected Risk Aversion Levels (Percent of Total Assets)

θ^a	Expected Income ^b	Variance	Corp. Bonds	Common Stocks	Farm Assets	Gov. Bonds	Money	Prime Rate	Small Stocks	T-Bills
<i>One-Year Holding Period</i>										
.075	14.2	90.87	.2	5.5	62.4	5.8	26.1	-66.7	0	0
.1	11.0	51.84	0	5.3	63.2	6.3	25.2	-57.0	0	0
.25	5.1	10.54	0	4.1	68.3	7.9	19.7	-8.5	0	0
.5	3.2	4.86	0	1.7	51.9	4.3	42.1	0	0	0
.75	1.3	3.83	0	.8	44.5	2.6	52.1	0	0	0
1	2.1	3.34	0	.3	39.8	2.8	41.6	0	.1	15.5
1.5	1.7	2.98	0	0	34.3	3.3	25.4	0	.4	36.5
2	1.5	2.86	0	0	31.5	3.6	17.5	0	.5	47.0
<i>Five-Year Holding Period</i>										
.025	80.6	1380.40	29.0	26.2	44.8	0	0	-53.0	0	0
.05	46.8	367.93	26.5	21.4	52.1	0	0	-24.8	0	0
.075	35.6	180.43	24.8	18.2	57.0	0	0	-5.9	0	0
.1	31.1	127.65	26.7	14.7	58.2	0	0	0	0	.4
.25	19.6	46.73	15.6	6.3	48.7	0	0	0	0	29.4
.5	15.5	34.49	8.9	3.6	45.5	0	7.5	0	0	34.4
.75	13.8	31.82	4.7	2.6	44.2	1.1	13.0	0	.1	34.3
1	12.2	29.91	1.1	1.2	42.5	4.7	15.6	0	1.0	34.8
1.5	11.0	28.86	0	0	41.2	4.2	16.9	0	1.7	36.0
2	10.8	28.75	0	0	40.7	3.6	17.7	0	1.8	36.3
<i>Ten-Year Holding Period</i>										
.025	143.4	2357.400	31.4	34.8	33.7	0	0	-42.1	0	0
.05	86.1	640.300	28.3	26.4	45.3	0	0	-13.8	0	0
.075	68.1	336.640	28.2	20.8	51.0	0	0	0	0	0
.1	59.0	232.150	26.5	15.8	50.3	0	0	0	0	7.4
.25	39.4	94.969	16.5	6.7	47.7	0	0	0	0	29.1
.5	31.9	73.141	9.6	3.8	46.5	0	5.6	0	0	34.6
.75	28.9	68.106	5.3	2.9	45.9	0	10.6	0	0	35.4
1	26.2	65.073	2.3	1.7	44.9	1.2	13.7	0	.6	35.6
1.5	23.5	62.783	0	.4	43.8	2.3	16.3	0	1.4	35.9
2	22.6	62.246	0	0	43.3	1.7	17.3	0	1.6	36.1

^aThe risk aversion coefficient in the model is interpreted as one-half of the Pratt-Arrow coefficient of relative risk aversion evaluated at initial wealth.

^bTotal returns (percent) over the holding period.

and ten-year planning horizons still show a greater percentage of farm assets in the portfolio than the historical 14 to 22 percent (Figure 2).

At higher levels of risk aversion the one-year model suggests portfolios with less than 14 percent farm assets when the variance to farm assets is quadrupled. The leveraged portfolios, corresponding to low levels of risk aversion, contain a large percent farm assets, probably due to the negative contemporaneous correlation of farm asset returns and prime interest rates.

Conclusions

Agricultural assets enter the EV efficient portfolios estimated in this study at levels

greater than are historically observed in the capital market. The results indicate that agricultural assets may have been underpriced relative to their risk and that investors can gain from inclusion of farm assets in their investment portfolios assuming that transaction costs are kept low. Those conclusions are robust to increasing the variance of rate of return to farm assets. Increased nonfarm investment in agriculture would enable the agricultural sector to become less dependent on debt financing, but perhaps with more outside control. The results suggest that nonfarm investors might react favorably to market instrument that would allow them to diversify into agriculture.

Figure 1. Farm Assets as a Percentage of Total Assets For One-, Five-, and Ten-Year Models at Selected Risk Aversion Levels

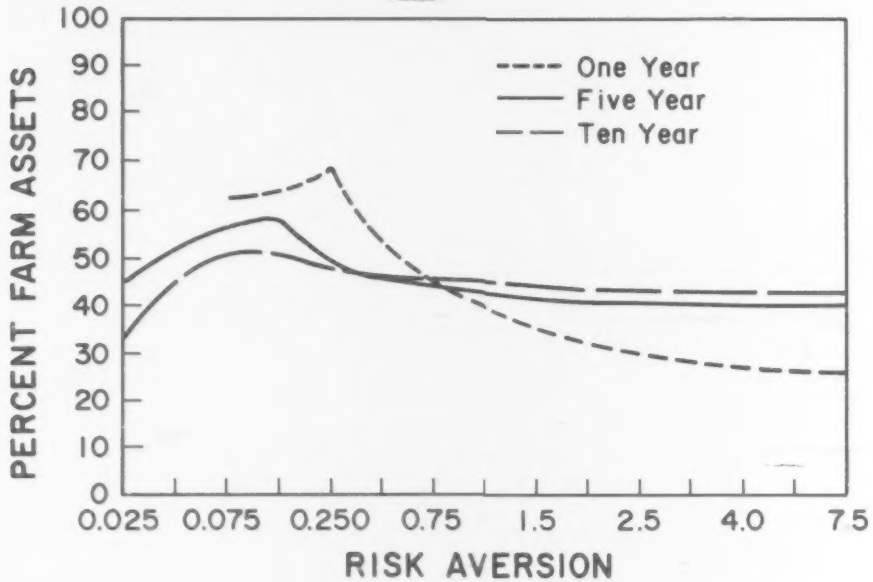
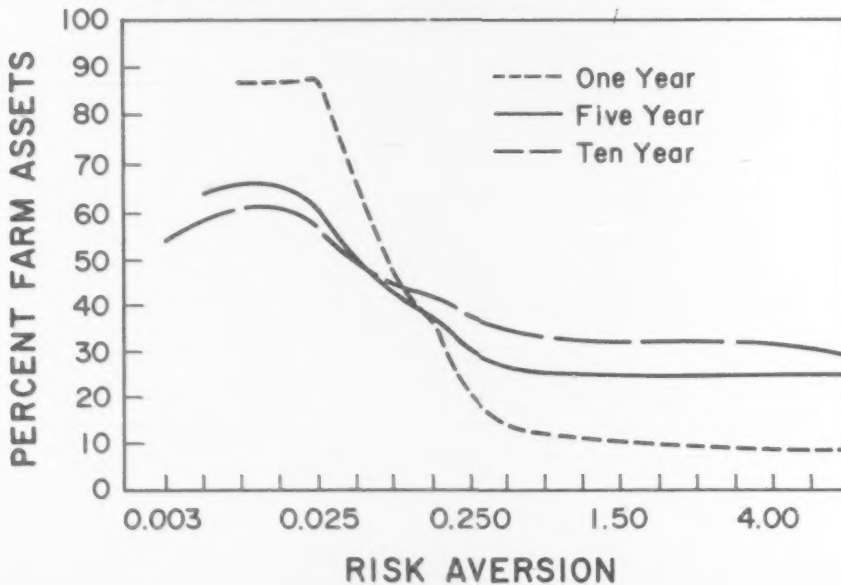


Figure 2. Farm Assets as a Percentage of Total Assets For One-, Five-, and Ten-Year Models with the Variance of Farm Returns Quadrupled at Selected Risk Aversion Levels



References

- Barry, Peter J. "Capital Asset Pricing and Farm Real Estate." *Amer. J. of Agr. Econ.* 62(1980):549-53.
- Board of Governors of the Federal Reserve System. *Banking and Monetary Statistics 1941-70*. Washington, DC: Board of Governors of the Federal Reserve System, 1976.
- _____. *Banking and Banking and Monetary Statistics*. Washington, DC: The National Capital Press, 1943.
- Collins, R.A. "Expected Utility, Debt-Equity Structure, and Risk Balancing." *Amer. J. of Agr. Econ.* 67(1985):627-29.
- Ibbotson Associates. *Stocks, Bonds, Bills, and Inflation: Quarterly Service*. Fourth Quarter 1984. Chicago: Ibbotson Associates, 1984.
- Ibbotson, Roger G., and Carol L. Fall. "The United States Market Wealth Portfolio." *J. of Portfolio Management* 5(Fall 1979):82-92.
- Johnson, S.R. "A Re-examination of the Farm Diversification Problem." *J. of Farm Econ.* 48(1967):610-21.
- Kroll, Y., H. Levy, and H.M. Markowitz. "Mean-Variance Versus Direct Utility Maximization." *J. of Fin.* 39(March 1984):47-61.
- Levy, H., and H.M. Markowitz. "Approximating Expected Utility by a Function of Mean and Variance." *Amer. Econ. Rev.* 69(1979):308-17.
- Lintner, John. "The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets." *Rev. of Econ. and Stat.* 47(February 1965):13-37.
- Malkiel, B. *A Random Walk Down Wall Street*. New York: Norton, 1973.
- Melichar, E. *Agricultural Finance Databook*. Washington, DC: Board of Governors of the Federal Reserve System, December 1984a.
- _____. *Farm Wealth: Origins, Impact, and Implications for Public Policy*. A.E. Res. 83-40. Cornell University Department of Agricultural Economics, June 1984b.
- Pulley, L.B. "A Generalized Mean-Variance Approximation to Expected Utility for Short Holding Periods." *J. of Financial and Quant. Analysis* 16(September 1981):361-73.
- Sharpe, William F. "Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk." *J. of Fin.* 19(September 1964):425-42.
- Sims, C.A. "Macroeconomics and Reality." *Econometrica* 48(1980):1-48.
- Tobin, J. "Liquidity Preference as Behavior Towards Risk." *Rev. of Econ. Studies* 15(February 1958):65-86.

Appendix 1

This appendix provides the mathematical derivation of the variance-covariance matrix for multiple-year portfolio models in which expectations follow a first order autoregressive process. A multivariate first order autoregressive process can be represented as

$$\epsilon_t = P \epsilon_{t-1} + \mu_t \quad (\text{A.1})$$

where ϵ_t is a $n \times 1$ vector of random variables (deviations of returns from their mean) that are a function of their past values ϵ_{t-1} and a vector μ_t . μ_t is a vector of white noise. White noise is the portion of error left after all systematic relationships between current and past errors have been removed. As a result, the μ_t vectors have the following white noise properties

$$\begin{aligned} E[\mu_t] &= 0, \\ E[\mu_t \mu_t'] &= \Omega, \\ E[\mu_t \mu_{t-1}'] &= 0 \text{ for all } i \neq 0, \\ E[\mu_t \mu_{t-i}'] &= 0 \text{ for all } i > 0. \end{aligned} \quad (\text{A.2})$$

The relationships in equation A.1 and the white noise assumptions in equation A.2 are used below to derive the variance-covariance matrix.

Assuming that the portfolio model does not have a specific starting year, the most appropriate starting value for ϵ_{t-1} is its expected value (zero). By definition, the variance of ϵ_t when $\epsilon_{t-1} = 0$ is

$$\begin{aligned} V[\epsilon_t] &= E[(P\epsilon_{t-1} + \mu_t)(P\epsilon_{t-1} + \mu_t)'] \\ &= E[\mu_t \mu_t'] - E[\mu_t]E[\mu_t'] \\ &= \Omega \end{aligned} \quad (\text{A.3})$$

The variance of ϵ_{t+1} is

$$\begin{aligned} V[\epsilon_{t+1}] &= E[(P\mu_t + \mu_{t+1})(P\mu_t + \mu_{t+1})'] - E[P\mu_t + \mu_{t+1}]E[P\mu_t + \mu_{t+1}]' \\ &= E[P\mu_t\mu_t'P' + P\mu_t\mu_{t+1}' + \mu_{t+1}\mu_t'P' + \mu_{t+1}\mu_{t+1}'] - 0 \\ &= P\Omega P' + \Omega \end{aligned} \quad (\text{A.4})$$

By extension variance for any year n is

$$\begin{aligned} V[\epsilon_{t+2}] &= PP\Omega P'P' + P\Omega P' + \Omega, \\ &\vdots \\ V[\epsilon_{t+n}] &= \sum_{i=0}^{n-1} P^i \Omega (P')^i, \end{aligned} \quad (\text{A.5})$$

where the exponent notation on the matrix P is as follows: $P^0 \equiv I$, $P^1 \equiv P$, $P^2 \equiv PP$, $P^3 \equiv PPP$, and so on.

To complete the matrix, the off diagonals are needed. The covariance between the first

period's error and the second period's error, given that ϵ_{t-1} is zero is

$$\begin{aligned} \text{Cov}(\epsilon_t, \epsilon_{t+1}) &= E[(\mu_t)(P\mu_t + \mu_{t+1})'] - E[\mu_t]E[P\mu_t + \mu_{t+1}]' \\ &= E[\mu_t\mu_t'P' + \mu_t\mu_{t+1}'] - 0 \\ &= \Omega P' \end{aligned} \quad (\text{A.6})$$

Similarly,

$$\begin{aligned} \text{Cov}(\epsilon_t, \epsilon_{t+2}) &= \Omega P'P' \\ &\vdots \\ \text{Cov}(\epsilon_t, \epsilon_{t+n}) &= \Omega (P')^n \end{aligned} \quad (\text{A.7})$$

The off diagonal elements are a general form of the diagonal term shown below

$$\begin{aligned} \text{Cov}(\epsilon_{t+1}, \epsilon_{t+1+n}) &= (P\Omega P' + \Omega) (P')^n, \text{ or} \\ \text{Cov}(\epsilon_{t+1}, \epsilon_{t+1+n}) &= V(\epsilon_{t+1}) (P')^n \end{aligned} \quad (\text{A.8})$$

In summary (A.9) is the variance-covariance matrix (Ω_T) for a T -year model using equations A.5 and A.8

$$\Omega_T = \begin{bmatrix} \Omega & P\Omega & PP\Omega & P^{T-1}\Omega \\ \Omega P' & (P\Omega P' + \Omega) & P(P\Omega P' + \Omega) \dots & P^{T-2}(P\Omega P' + \Omega) \\ \Omega P'P' & (P\Omega P' + \Omega)P' & (PP\Omega P'P' + P\Omega P' + \Omega) \dots & P^{T-3} \sum_{i=0}^2 P^i \Omega (P')^i \\ \vdots & \vdots & \vdots & \vdots \\ \Omega (P')^{T-1} & (P\Omega P' + \Omega)(P')^{T-2} & \sum_{i=0}^2 P^i \Omega (P')^i (P')^{T-3} \dots & \sum_{i=0}^{T-1} P^i \Omega (P')^i \end{bmatrix} \quad (\text{A.9})$$

Matrix A.9 can be used in conjunction with results from a first order vector autoregression to determine the variance-covariance coefficients for a T -period model. There are mT rows and columns in Ω_T , where m is the number of investment activities. The matrix Ω is the $m \times m$ variance-covariance matrix of the residuals and the $m \times m$ matrix P is the matrix of regression coefficients.

Analyzing Change: The Statement of Changes in Financial Position

Ralph Brubaker and Thomas L. Frey

Abstract

A newly designed format for the "Statement of Changes in Financial Position" (SCFP) is proposed for use in agriculture. As a basis for the proposal, this article defines "funds," traces the history of the SCFP, and summarizes current requirements of Accounting Principles Board (APB) Opinion No. 19, the existing authoritative guide for the SCFP. Current proposals from the accounting industry are reviewed, and the proposal for agriculture is related to emerging trends and standards, as well as to existing standards. The proposed format is unique in that its design emphasizes direct use of the SCFP for analyses that could be used widely by farmers and lenders alike.

Key words: flow of funds, statement of changes in financial position, farm financial analysis, accounting for agriculture, financial statements.

The financial crisis in agriculture is forcing lenders and farmers alike to reassess concepts and procedures for gathering, organizing, and analyzing farm financial data. Historically in agriculture, lenders have provided the major motivation for preparation of financial statements, with balance sheets the focal point. Accrual income statements and cash flow projections are gaining popularity, but use of the SCFP in agriculture is still quite limited. With so much at stake for farmers and lenders in having accurate and complete financial analysis, perhaps use of the SCFP is an important missing link in presentation of financial data.

Agricultural finance economists are perhaps best equipped to assume some responsibility for improving the state of the art of farm financial data organization and presentation.

This article provides background on the development and use of the SCFP, summarizes recent proposals for changes in the SCFP, and presents a SCFP format for use in agriculture. The proposed format is in accordance with Accounting Principles Board (APB) Opinion No. 19 (American Institute of Certified Public Accountants). It is theoretically and conceptually consistent with emerging trends and standards in the accounting profession as described in an exposure draft for proposed standards by the Financial Accounting Standards Board (FASB), 1986.

The primary objective of the article is to present a means for enhancing the presentation of farm financial data for use by owners and other users of the financial statements. Simultaneously it allows movement toward generally accepted accounting principles (GAAP) for farm financial data. APB No. 19 states the conclusion that "the financing and investing activities of a business enterprise and the

Ralph Brubaker, C.P.A., is a graduate research assistant in the Department of Agricultural Economics and a student in the College of Law at the University of Illinois. Thomas L. Frey, C.P.A., is a professor in the Department of Agricultural Economics, University of Illinois. Authors gratefully acknowledge helpful review comments on an earlier draft from James Canron, Paul Ellinger, Steve Hofing, Bruce Jones, David Lins, Mike Mazzocco, Dick Wittman, and three anonymous reviewers for *Agricultural Finance Review*.

changes in its financial position for a period is essential for financial statement users, particularly owners and creditors, in making economic decisions (AICP)."

Linkages Among Farm Financial Statements

This article assumes an *accrual* balance sheet and income statement as a point of departure. Accrual adjustments to cash data maintained by farmers would typically facilitate such statements.

A balance sheet is a static statement. It reveals a farm's financial position at a specific point in time by identifying the assets and liabilities from which the owner's equity is determined. Successive balance sheets show changes in financial position but provide no information about the cause of changes. The income statement is a flow statement summarizing revenue and expense flows from the normal, recurring operations of the farm enterprise that affect net income. Determining net income is a prerequisite for the statement of owner's equity, which summarizes all flows that affect net worth, namely, net income, net withdrawals, gifts made and received, inheritances, other external contributions of capital, and equity retirement. From that it is possible to see how and why owner equity changes from the beginning to the end of the period.

But owner equity is only part of the total financial position. The basic accounting equation shows that changes in owner equity are merely the residual effect of changes in a farm's assets and liabilities.

$$\begin{aligned} \text{Assets} &= \text{Liabilities} + \text{Owner's Equity} \\ \text{Owner's Equity} &= \text{Assets} - \text{Liabilities} \\ \Delta \text{ in Owner's Equity} &= \Delta \text{ in Assets} - \Delta \text{ in Liabilities} \end{aligned}$$

Thus, to understand all changes in a farm's financial position, it is necessary to go beyond examining changes in owner's equity and analyze changes in assets and liabilities. In other words, the impact of *investing* and *financing* activities must be examined in addition to evaluating how *operations* affect financial position. The SCFP captures all changes in financial position by

showing the effects of operations, investment, and financing activities.

Changes in assets and liabilities are made through management decisions in three areas: (a) operations, (b) investment, and (c) financing (Helfert). *Operations* encompass the central, ongoing operating activities of the farm enterprise. As such, changes in financial position resulting from operations arise from income-producing activities and family living. Family living withdrawals are included in operations as a proxy for unpaid labor and management provided by the owner and other family members.

Investment is defined as changes in a farm's assets outside of the central, ongoing operating activities. Assets that are not produced, sold, or consumed in the normal course of business operations are typically called capital assets.

Financing refers to changes in a farm's liabilities outside of the central, ongoing operating activities of the farm, external contributions of capital, and retirement of equity. Increases in or repayment of debt outside of the normal course of business are often referred to as transactions in nontrade debt, typically labeled as operating notes and term debt.

The SCFP summarizes *all* changes in a farm's financial position. It provides financial information beyond that contained in a balance sheet, income statement, and statement of owner's equity, as it summarizes transactions involving capital assets and nontrade debt. It not only shows how *operations* affect financial position but also presents the effects of *investing* and *financing* activities. The SCFP accomplishes that by summarizing flows of funds.

Funds Defined

What constitutes *funds* in an accounting sense is a somewhat elusive concept. The definition is based on what is termed the *all financial resources* concept—a broader idea than just cash. *Funds* are best understood by thinking in terms of transactions that do one of the following: increase or decrease assets, liabilities, or owner's equity. Sources and uses of funds are as follows:

Sources of Funds

1. Decrease in Assets
2. Increase in Liabilities
3. Increase in Owner's Equity

Uses of Funds

1. Increase in Assets
2. Decrease in Liabilities
3. Decrease in Owner's Equity

If every transaction must satisfy the basic accounting equality of *Assets = Liabilities + Owner Equity*, then it follows that every transaction must also satisfy the equality of *Sources of Funds = Uses of Funds*. Finally, with every transaction being both a source and a use of funds, the SCFP summarizes all transactions, and, thus, captures all changes in financial position.

History of the SCFP in the Accounting Profession

The SCFP was adapted for the agricultural industry in 1978 (Frey and Klinefelter), but it never achieved widespread use. For the nonagricultural world it has been in existence since the 1860s. It has had several other names, including "Funds Flow Statement" and "Statement of Sources and Applications of Funds." The funds statement first gained authoritative support in the accounting profession in 1963 with the issuance of Accounting Principles Board (APB) Opinion No. 3, which recommended inclusion of the funds statement in corporate annual reports. In 1969, the Securities and Exchange Commission (SEC) began requiring firms to include audited funds statements in their periodic reports to the SEC. Then, in 1971, the Accounting Principles Board issued Opinion No. 19, *Reporting Changes in Financial Position*, which requires companies to issue a funds statement in order for their financial statements to be in accordance with GAAP. APB Opinion No. 19 also changed the name of the funds statement to the statement of changes in financial position (SCFP). Thus the accounting profession and business community gave the SCFP equal status with the balance sheet and income statement as a primary financial statement.

Statement Format

APB Opinion No. 19 allows much flexibility in presentation of the SCFP. Several formats have developed in practice. The presentation among the formats currently in use differs in three areas: (a) cash-based or working

capital-based funds, (b) balanced or residual format, and (c) direct or indirect approach.

Cash-based vs. working capital-based funds.

APB Opinion No. 19 requires all transactions affecting financial position to be captured, but allows flexibility in the basis of the funds. A cash-based SCFP is a cash flow statement using the *all financial resources* concept of cash flows. A working capital-based SCFP presents funds flows in terms of their effect on working capital (defined as current assets minus current liabilities). The cash-based SCFP reconciles changes in cash, while the working capital-based SCFP reconciles changes in working capital.

Balanced vs. residual format. The SCFP commonly shows total sources of funds and total uses of funds. Under the balanced format, the change in funds (cash or working capital) is included as a source or a use of funds; and thus, total sources equal total uses of funds.

Under the residual format, the change in funds is not included as a source or a use of funds. Instead, total uses of funds are deducted from total sources of funds, and the change in funds becomes the bottom line.

Indirect approach vs. direct approach.

The indirect method starts with accrual net income before consumption withdrawals and is first adjusted for family living withdrawals. Then a series of net income adjustments is made for items involved in the original determination of net income, but that had no impact on cash or working capital. Funds from operations are thus determined. Gross investment and financing activities are summarized into either sources or uses of funds, with the bottom line being a change in either cash or working capital.

The direct method of reporting differs from the indirect method in the presentation to determine funds from operations. The direct method reports gross revenue from farm production activities, and net nonfarm income. Then gross outlays are shown for consumption withdrawals, operating expenses, interest, and income and social security tax. That is in contrast to starting with net income and making a series of adjustments.

New Direction for the SCFP

Even though the SCFP has become an accepted statement in the nonagricultural business world, its potential for financial analysis has not been reached. Much of the problem centers around the former widespread use of the indirect approach with a working capital basis of funds. That format is very confusing, so there has been a widespread effort in the accounting profession to move away from the working capital SCFP to the cash-based SCFP (Campbell et al.; Clark; Clement; Coleman; Golub and Huffman). Others emphasize more disclosure needs (Buzby and Falk), while significant debate was created with a proposal to replace the existing funds statement with several more specific statements (Heath; replies in "Professional Notes"). In 1980 and 1981, the SEC made moves to require management to explicitly discuss cash flows in annual reports. In 1980, FASB issued a discussion memorandum on reporting funds flows and a subsequent exposure draft of a proposed Statement of Financial Accounting Concepts, *Reporting Income, Cash Flows, and Financial Position of Business Enterprises*. One of the conclusions of the exposure draft was that reporting cash flows is generally more useful than reporting changes in working capital. Shortly after the exposure draft was issued, the Financial Executives Institute (FEI) began urging its member companies to adopt cash-based SCFPs (Clark). In December of 1984, FASB issued Statement of Financial Accounting Concepts No. 5, *Recognition and Measurement in Financial Statements of Business Enterprises*, which concludes that, in concept, a cash flow statement is part of a full set of financial statements. In July 1986, FASB issued an exposure draft of a proposed Statement of Financial Accounting Standards, *Statement of Cash Flows*. The proposed statement would supersede APB Opinion No. 19 and would require that a statement of historic cash flows be presented as part of a full set of financial statements in accordance with generally accepted accounting principles. The statement of cash flows would replace the SCFP required by APB Opinion No. 19. The exposure draft attracted substantial response and concerns causing FASB to issue a new exposure draft including proposals for one or more schedules in addition to the cash flow analysis. It is

scheduled for release in the summer of 1987, with an additional sixty-day comment period. It is now anticipated that a final pronouncement will be out by mid-1988.

The authors agree that changes in currently used SCFP formats are needed but favor retaining the working capital-based approach to be used in conjunction with the cash-based SCFP format, as was proposed in 1984 (Bryant). Both provide useful information, especially for analyses in the agricultural industry.

Currently APB No. 19 still governs the accounting requirements for including SCFP as part of a full set of financial statements. It offers considerable flexibility but focuses more on working capital and specifically requires a schedule that discloses the net change in the elements of working capital; however, it also permits reporting cash flows. The draft proposed from FASB on *Statement of Cash Flows* requires information about the cash receipts and cash payments of an entity during a period, as well as a reporting of effects of investing and financing transactions that do not directly affect cash. It appears an inclusion of working capital analysis will be permitted if that is beneficial for the entity in question.

The balance of this article develops a proposed format for use with farm and ranch operations. It is driven most by the need for a document that best organizes data for financial analysis and that can be completed along with a balance sheet and income statement done on a conversion of cash basis data to accrual basis. The second driving force is to approach the accounting profession requirements for GAAP without proposing something that farmers, ranchers, and lenders would find unacceptable.

A real problem of SCFP acceptance has been that most SCFPs have segregated sources from uses, using either the balanced or residual format. In order to make the SCFP a useful statement for analyses in agriculture, we reject both the balanced and residual approaches, as does the proposed *Statement of Cash Flows* (FASB). Since the FASB proposals are still being debated and altered we are concentrating on a format that best organizes the data for analysis as needed in agriculture.

The proposed format is illustrated in Figure 3, which results from information in Figures 1 and 2. The balance sheet and income statement uses the direct approach and is in full compliance with APB Opinion No. 19, because it (a) uses the *all financial resources* concept of funds; (b) prominently discloses funds provided by operations; and (c) has an accompanying schedule that discloses the net changes in the elements of working capital. Based on the July 1986

exposure draft from FASB, the proposal seems conceptually consistent with what will likely emerge. The SCFP title is being retained until something more definite is available from FASB.

The format presents both cash-based and working capital-based funds and adjustments between the two. It organizes sources and uses of funds into *flows* designed to emphasize that the ongoing source of funds

Figure 1. IMA Farmer Balance Sheets as of 31 December 1985 and 31 December 1986

	As of 12/31/85	As of 12/31/86	Change		As of 12/31/85	As of 12/31/86	Change
<i>Current Assets</i>				<i>Current Liabilities</i>			
Cash	\$2,000	\$1,000	(\$1,000)	Accounts Payable	\$2,500	\$4,000	\$1,500
Accounts Receivable	\$1,000	\$1,500	\$500	Operating Loans			
				Due within 1 yr.	\$50,000	\$65,000	\$15,000
Livestock to be Sold	\$80,000	\$85,000	\$5,000	Prin. Portion of			
				Longer Term			
Crops and Feed	\$70,000	\$72,000	\$2,000	Debt Due within			
				1 yr.	\$25,000	\$25,000	\$0
Prepaid Expenses	\$1,500	\$1,000	(\$500)	Accrued Interest	\$13,750	\$15,000	\$1,250
				Accrued Property			
				Taxes	\$1,200	\$1,200	\$0
				Accrued Income and			
				S.S. Taxes	\$8,000	\$9,000	\$1,000
TOTAL CURRENT ASSETS	\$154,500	\$160,500	\$6,000	TOTAL CURRENT LIABILITIES	\$100,450	\$119,200	\$18,750
<i>Intermediate Assets</i>				<i>Intermediate Liabilities</i>			
Machinery and Equipment							
Cost	\$100,000	\$126,000	\$26,000				
Acc-dep	(\$28,000)	(\$43,000)	(\$15,000)				
Book Value	\$72,000	\$83,000	\$11,000				
Breeding Stock							
Cost	\$40,000	\$49,000	\$9,000				
Acc-dep	(\$12,000)	(\$17,000)	(\$5,000)				
Book Value	\$28,000	\$32,000	\$4,000				
TOTAL INTERMEDIATE ASSETS	\$100,000	\$115,000	\$15,000	TOTAL INTERMEDIATE LIABILITIES	\$0	\$0	\$0
<i>Fixed Assets</i>				<i>Long-Term Liabilities</i>			
Farm Real Estate & Bldgs.				Real Estate & Bldg.			
Cost	\$200,000	\$200,000	\$0	Loans	\$250,000	\$225,000	(\$25,000)
Acc-dep	(\$50,000)	(\$60,000)	(\$10,000)				
Book Value	\$150,000	\$140,000	(\$10,000)				
TOTAL FIXED ASSETS	\$150,000	\$140,000	(\$10,000)	TOTAL LONG-TERM LIABILITIES	\$250,000	\$225,000	(\$25,000)
				TOTAL LIABILITIES	\$350,450	\$344,200	(\$6,250)
				TOTAL OWNER EQUITY	\$54,050	\$71,300	\$17,250
TOTAL ASSETS	\$404,500	\$415,500	\$11,000	TOTAL LIABILITIES AND OWNER EQUITY	\$404,500	\$415,500	\$11,000

Figure 2. IMA Farmer Income Statement for the Year Ending 31 December 1986*Revenues*

Crops and Feed		
Cash Sales	\$140,000	
Inventory Change Adjustment	\$2,000	\$142,000
Livestock		
Cash Sales	\$125,000	
Inventory Change Adjustment	\$5,000	\$130,000
Change in Accounts Receivable Adjustment		\$500
TOTAL REVENUE		\$272,500
Less Livestock & Other Purchases for Resale		(\$60,00)
Value of Farm Production		\$212,500

Expenses

Cash Operating Expenses		\$100,000
Expense Adjustment (unused assets)		
Change in Prepaid Expenses	\$500	\$500
Expense Adjustment (unpaid items)		
Change in Accounts Payable	\$1,500	
Change in Accrued Property Taxes	\$0	\$1,500
Depreciation		
Machinery & Equipment	\$20,000	
Breeding Stock	\$5,000	
Real Estate & Improvements	\$10,000	\$35,000
Interest Expense		
Cash Interest Expense	\$33,000	
Change in Accrued Interest Adjustment	\$1,250	\$34,250
TOTAL EXPENSES		\$171,250
Net Farm Income From Operations		\$41,250
Gain (Loss) on Disposal of Capital Assets		\$10,000
Net Farm Income		\$51,250
Net Nonfarm Income		\$0
Net Income Before Taxes		\$51,250
Income & Social Security Taxes		
Cash Paid for Income & S.S. Taxes	\$8,000	
Change in Acc. Income & S.S. Taxes Adj.	\$1,000	(\$9,000)
NET INCOME		\$42,250

for a farm business is the net income-producing activity of the farm. Funds provided by that activity are available to provide for family living withdrawals and scheduled principal payments on term debt. Capital purchases can be made from any residual operating funds, capital asset sales, and/or external financing. To the extent these are aggregately insufficient, there will be a deterioration in funds position.

Family living withdrawals are segregated from *net income*, to recognize that although family living withdrawals do represent a

proxy for the operator's labor and management they are discretionary outflows, and the dollar amount may or may not be positively correlated with the amount of *net income*.

The format highlights, for lenders, how borrowers generate funds to repay principal and interest obligations, reveals how expansion is financed, and indicates financial deterioration when it occurs. Analysis is in two areas: (a) cash flow and (b) working capital.

Figure 3. IMA Farmer Statement of Changes in Financial Position for the Year Ending 31 December 1986

Sources of Cash and/or Working Capital (WC)	Cash-Based Funds	WC-Based Funds	Adjustments For Reconciling Cash to WC
Cash and/or WC from Farm Production	\$205,000	\$212,500	\$7,500
Cash and/or WC for Operating Expenses	(\$100,000)	(\$102,000)	(\$2,000)
Cash and/or WC for Interest	(\$33,000)	(\$34,250)	(\$1,250)
Cash and/or WC from Net Nonfarm Income	\$0	\$0	\$0
Cash and/or WC for Income & S.S. Taxes	(\$8,000)	(\$9,000)	(\$1,000)
NET CASH OR WC INCOME	\$64,000	\$67,250	\$3,250
Family Living Withdrawals	(\$25,000)	(\$25,000)	\$0
CASH OR WC FROM OPERATIONS	\$39,000	\$42,250	\$3,250
Scheduled Principal Payments on Term Debt	(\$25,000)	(\$25,000)	\$0
CASH OR WC AFTER SCHEDULED PRINCIPAL PAYMENTS	\$14,000	\$17,250	\$3,250
Capital Asset Purchases			
Machinery & Equipment	(\$58,000)	(\$58,000)	\$0
Breeding Stock	(\$12,000)	(\$12,000)	
Capital Asset Sales			
Machinery & Equipment	\$37,000	\$37,000	\$0
Breeding Stock	\$3,000	\$3,000	\$0
Other Principal Payments on Term Debt	\$0	\$0	\$0
CASH OR WC BEFORE EXTERNAL FINANCING	(\$16,000)	(\$12,750)	\$3,250
New Term Debt	\$0	\$0	\$0
Change in Operating Debt	\$15,000	\$0	(\$15,000)
CASH OR WC AFTER EXTERNAL FINANCING	(\$1,000)	(\$12,750)	(\$11,750)
CHANGE IN CASH OR WC	(\$1,000)	(\$12,750)	(\$11,750)

Schedule of Changes in Working Capital Items

	Change	WC Change
Farm Production Related		
Accounts Receivable	\$500	\$500
Livestock to be Sold	\$5,000	\$5,000
Crops and Feed	\$2,000	\$2,000
		\$7,500
Operating Expense Related		
Prepaid Expense	(\$500)	(\$500)
Accounts Payable	\$1,500	(\$1,500)
		(\$2,000)
Accrued Interest	\$1,250	(\$1,250)
Accrued Income & S.S. Taxes	\$1,000	(\$1,000)
Nonoperating		
Operating Loans Due within 1 yr.	\$15,000	(\$15,000)
Current Portion of Term Debt	\$0	\$0
Cash	(\$1,000)	(\$1,000)
		(\$16,000)
TOTAL CHANGE IN WORKING CAPITAL		(\$12,750)

Cash Flow Analysis

A cash-based SCFP is merely a cash flow statement or a summary of all cash inflows and outflows using the *all financial resources* concept. The cash flow statement familiar to most agricultural lenders and producers projects monthly cash flows in order to project operating credit needs, typically separating receipts and expenditures into detailed categories. For analytical purposes, that added detail is not always necessary. The SCFP on a cash basis presents annual cash flows in summary categories, organized to show cash generated and used by all three of the financial management decision areas of the business: operations, investment, and financing.

Either a historical basis or a pro forma basis can be used. If detailed monthly cash flow projections are available, the SCFP can be prepared by simply aggregating the details.

The need for cash flow data stems from the fact that cash must be available for interest payments, family living expenses, and scheduled principal payments on term debt. The usefulness of the cash-based SCFP lies in the way in which the cash flows are organized to show how cash is generated. The five key figures on the cash-based SCFP are: (a) net cash income, (b) cash from operations, (c) cash after scheduled principal payments, (d) cash before external financing, and (e) cash after external financing or change in cash (Figure 3).

Net cash income. It represents the net effects of all cash items on the income statement, indicating whether the income-producing activities of the farm are a net source or a net use of cash. If negative, any deficit must be covered by additional external financing, sales of capital assets, and/or a decrease in cash balances.

Cash from operations. This reveals whether operations were sufficient to also cover gross cash family living withdrawals. If negative, then operations have not generated sufficient cash to cover all cash expenses and gross family living withdrawals. The deficit must be covered by additional external financing, sales of capital assets, and/or a decrease in cash balances.

Cash after scheduled principal payments on term debt. Scheduled payments on term debt refers to those principal payments due during the year and shown on the beginning balance sheet as the current portion of term debt. Payment in excess of the scheduled amount is not included. At this point the presentation reveals whether the operation has generated sufficient cash to meet expenses and withdrawals plus scheduled principal payments on term debt. A negative number indicates a deficiency that would have to be paid from additional external financing, sales of capital assets, and/or a decrease in cash balances. For a farm to remain solvent and continue to make scheduled principal payments, to cover all cash expenses including cash interest payments, and to meet gross family outlays, *cash after scheduled principal payments, on average*, must remain positive.

"On average" simply suggests the value may dip below zero for a particular year, but over time, the figures should average to positive amounts if the business is to remain viable. For example, *cash after scheduled principal payments* may be negative one year because the farmer has built up grain inventories for feed in anticipation of a major expansion of the livestock enterprises. The situation reverses with expanded livestock sales in a later period.

Cash before external financing. This reflects the net cash position after operations, scheduled principal payments, capital asset purchases, capital asset sales, and additional principal payments on term debt beyond the scheduled amounts. Capital purchases can be financed by positive *cash after scheduled principal payments*; the net proceeds of capital asset sales after retiring associated debt obligations, additional external financing, and/or a decrease in cash balances. Unlike *net cash income*, *cash from operations* and *cash after scheduled principal payments*, there is no expectation that a solvent farm maintain a positive cash position before external financing. There is no reason that the entire amount of capital purchases should be financed internally from the current year's operations and/or capital sales. Because capital assets will generate cash inflows during future periods, capital purchases are typically financed, at least partially, by new debt to be repaid in the

future from those cash inflows. A deficit in cash funds before external financing must be financed by additional external financing or a decrease in cash balances.

The level of *cash before external financing* is useful to indicate whether interest payments, family living withdrawals, or scheduled principal payments on term debt are met by liquidation of capital assets. If the net effects of capital-asset purchases and sales, plus additional principal payments on term debt, generates an increase in cash, then any deficit in *net cash income, cash from operations, or cash after scheduled principal payments* is financed, at least partially, by the sale of capital assets. Capital asset sales can also be used to finance capital asset purchases and additional principal payments on term debt.

The way in which the farm obtains external financing is indicated by *new term debt* and *change in operating debt*. *Cash after external financing* or *change in cash* indicates the extent to which cash position increases or decreases during the year.

New term debt and *change in operating debt* indicate the absolute and relative amounts of new short- and long-term credit used by the farm. That is important in analyzing whether the operation is maintaining a proper debt structure. Capital expenditures are usually financed through long-term credit, but temporary operating deficits are usually financed by an increase in operating debt.

The discussion of cash-based funds has focused on the ability of a farm to carry an existing debt load and make cash interest and principal payments from cash generated by normal operations. But what if *cash after scheduled principal payments* is negative for a particular year? What if *cash after scheduled principal payments* is positive—can the farm's current operations support an even larger debt load? Those questions are answered through analysis of capital debt repayment capacity by examining the working capital-based SCFP.

Capacity Analysis

Although it is cash that actually pays operating costs, family living costs, principal and interest on term debt, and outlays for

capital assets, cash flows can be subject to manipulation and misinterpretation. For example, a farm may be increasing its debt load to facilitate expansion. Increased cash inflows are not yet being realized; thus cash repayment ability may be weak until the expansion generates additional cash. Likewise, a change in marketing plans may defer cash sales. With significant financial stress a rather common practice has been sale of inventory of grain or livestock from a previous production period to generate cash for a current period and/or a significant increase in accounts payable in lieu of cash outlays for purchase of inputs. Although it is important to understand cash flow patterns and how they affect a farm's financial position, more information is needed to have a complete picture of how well the business is doing. To explore the accrual-based capacity to meet operating costs, family living costs, principal and interest payments on term debt, and purchase of capital assets, accrual net income becomes the point of departure. Although it is cash that ultimately pays all costs, the ongoing *capacity* to generate cash and to pay all costs stems from profitability defined as accrual net income. The accrual version of funds generated by operations is *working capital from operations*, more commonly known in agriculture as capital debt repayment capacity. The term correctly conveys the idea that working capital from operations represents the farm's capacity to make scheduled principal payments on term debt.

As was the case with cash flow evaluation, capacity analysis can be done on both historical and projected data. Historic data would be used in evaluating financial position and past performance, but projected data may be the most useful in making borrowing decisions. Here we ask, "Does the farm have adequate repayment capacity to repay this loan?" and "Is the capacity margin high enough to finance capital purchases along with external financing and cover any uncertainties or unexpected events?"

The first question relates to the farm's working capital income, working capital from operations, and its working capital after scheduled principal payments. An analysis of those numbers over time and into the future indicates the capacity of the farm operation to carry debt.

Net working capital income greater than zero indicates accrual revenue in excess of expenses, including interest. *Working capital from operations* is the result of deducting net family living withdrawals. *Working capital after scheduled principal payments* shows what is left after the deduction of scheduled principal payments on term debt. That figure must, on average, remain positive if the operation is to remain solvent.

Note that *scheduled principal payments on term debt* (working capital basis) denotes the amount of principal that will be transferred into current liabilities at year-end, from either the intermediate- or long-term liability sections. The increase in current liabilities caused by transfer of debt into the current section decreases working capital. That transaction does not affect cash. In contrast, the cash basis procedure evaluates amount of scheduled cash principal payments actually made on the term debt in the current year. It is important to keep those differences in mind when analyzing the data.

The *working capital after scheduled principal payments* represents the farm's capacity margin above what is already required for expenses, family living withdrawals, and principal payments on term debt. It can be used to finance capital purchases, to build reserves for unforeseen expenditures, as a cushion for fluctuations in capacity, to capitalize additional expansion, or to make investments outside the farm operation. The appropriate margin level will differ from farm to farm and lender to lender. The desired level also depends upon the level of uncertainty inherent in any projected data.

Working capital before external financing represents the capacity of the farm after the effects of capital purchases and sales. Cash and capacity analyses are exactly the same for capital asset purchases and sales, and other principal payments on term debt. And working capital before external financing may be negative when large capital purchases are made during a given year.

Notice that working capital sources of external financing do not include change in operating debt, because changes in operating debt have no net effect upon working capital. *Working capital after financing* equals the change in working capital for the year. That

number indicates whether working capital position has strengthened or deteriorated.

The *schedule of changes in working capital items* is included in Figure 3 as required by APB No. 19.

Conclusion

Producers, lenders, and regulators are all seeking insights on how to better analyze performance of farm operations. Use of the SCFP may be the missing link, especially if it ties directly to financial analysis. An accrual-based income statement and beginning and end of period balance sheets are assumed prerequisites.

This article has reviewed trends, developments, and current use of the SCFP, and based on that, has proposed a format design of the SCFP that would both meet the needs of the agricultural industry and still conform to APB Opinion No. 19. This SCFP summarizes data on both a cash basis and on a working capital basis, the latter relating closely to the capital debt repayment capacity concept, familiar to many lenders. Decision makers (producers, lenders, regulators) need the insight offered by both approaches. The cash-based funds format offers a concise and useful annual summary of the detailed and sometimes unwieldy monthly cash flow statement. With the simultaneous working capital analysis, a far more accurate analysis can be made of the future impacts that will likely follow from the actual or projected cash flows.

References

- American Institute of Certified Public Accountants. *Reporting Changes in Financial Position*. Accounting Principles Board Opinion No. 19. New York: American Institute of Certified Public Accountants, 1971.
- Bryant, Julie V. "Proposed: A New Statement of Changes." *Management Accounting*, April 1984, 49-52.
- Buzby, Stephen L., and Haim Falk. "A New Approach to the Funds Statement." *J. of Accountancy*, January 1974, 55-61.
- Campbell, David R., James M. Johnson, and Leonard M. Savoie. "Cash Flow, Liquidity, and

Financial Flexibility." *Financial Executive*, August 1984, 14-17.

Clark, Richard S. "Statement of Changes: In Need of a Change? Let's Put Cash on the Bottom Line." *C.A. Magazine*, February 1983, 26-30.

Clemente, Holly A. "The Funds Flow Statement: Striving for Greater Accuracy." *Financial Executive*, December 1982, 27-32.

Coleman, Almand R. "Restructuring the Statement of Changes in Financial Position." *Financial Executive*, January 1979, 34-42.

Financial Accounting Standards Board. *Recognition and Measurement in Financial Statements of Business Enterprises*. Statement of Financial Accounting Concepts No. 5, Stamford, CT: Financial Accounting Standards Board, 1984.

_____. "Reporting Funds Flows, Liquidity, and Financial Flexibility." Discussion memorandum, 1980.

_____. "Reporting Income, Cash Flows, and Financial Position." Exposure draft of a proposed Statement of Financial Accounting Concepts, 1981.

_____. *Status Report*. No. 167, June 12, 1985, and No. 168, July 10, 1985.

_____. "Statement of Cash Flows." Exposure draft of a proposed Statement of Financial Accounting Standards, 1986.

Frey, Thomas L., and Danny A. Klinefelter. *Coordinated Financial Statements for Agriculture*. 2d e. Skokie, IL: AgriFinance, 1980.

Golub, Steven J., and Harry D. Huffman. "Cash Flow: Why It Should Be Stressed in Financial Reporting." *Financial Executive*, February 1984, 34-40.

Heath, Loyd C. "Let's Scrap the 'Funds' Statement." *J. of Accountancy*, October 1978, 94-103.

Helfert, Erich A. *Techniques of Financial Analysis*. 4th ed. Homewood, IL: Richard D. Irwin, Inc., 1977.

"Professional Notes." *J. of Accountancy*, December 1979, 88-96.

The Effects of Tenure Position on Farm Profitability and Solvency: An Application to Illinois Farms

Paul N. Ellinger and Peter J. Barry

Abstract

The financial crisis in agriculture has focused greater attention on measuring the financial performance of farm businesses with different structural characteristics. Data from the Illinois Farm Business Records and the Farm Credit System are used to measure the empirical relationships between tenure and two key performance measures: profitability and solvency. A microcomputer-based model is used to simulate future performance. Results indicate that both accounting rates of return and debt-to-asset ratios increase as the ratio of leased land to total land operated increases.

Key words: profitability, simulation, solvency, tenure.

The financial adversities of the 1980s have placed greater importance on measuring farm financial performance. However, the diversity of farm businesses hampers comparisons of farms with different structural characteristics. Much of the literature uses the debt-to-asset ratio as an indicator of financial stress (Food and Agricultural Policy Institute [FAPRI]; Jolly and Doye; USDA 1985). The USDA study, for example, categorizes farms into different stress categories based on debt-to-asset ratios, and considers how leverage varies with farm size, enterprise type, and location. However, the performance implications of a farm's tenure position has received little attention, and even then, only three discrete tenure classes—pure tenant, part owner, and full owner—generally are considered (Scott).

Tenure is important because considerable land is operated by farms under various types of leasing arrangements. About 40 percent of all farms in the U.S. and almost 67 percent of the farm land have been operated by farmers who lease part or all of their land (USDA 1984). In addition, the typical levels of key performance measures tend to differ with a farm's tenure position. For example, with other factors constant, a higher ratio of leased to owned land is likely associated with higher accounting rates of return to farm assets, higher financial leverage, and higher liquidity. Past studies (for example, Scott) provide evidence consistent with those observations.

Farm operators have traditionally experienced relatively low accounting rates of return on land due to its nondepreciability (Barry and Robison) and because part of the return to land accrues as unrealized capital gains. Thus, farm land has not generated all of the cash flow needed to repay loans for

land investments. These conditions translate into lower levels of debt carrying capacity (and thus lower leverage) for land investments compared with other types of assets. As tenancy increases, higher leverage and higher accounting rates of return to the operator's farm assets are anticipated because land is a lower proportion of total assets.

The major objective of this study is to evaluate the effects of farmers' tenure position on key characteristics of financial performance. A secondary objective is to evaluate the performance effects of possible relationships between tenure and farm size. We will empirically test the relationships hypothesized above under the significant changes in financial conditions in the 1970s and 1980s, develop performance norms under different tenure positions, and simulate future farm performance under different tenure positions. The data sources are the Illinois Farm Business Farm Management Association (FBFM) and loan records of the St. Louis Farm Credit Banks (FCB). A farm-level simulation model is used to project farm financial performance under different tenure positions. The procedures, results, and implications are presented in the following sections.

Historical Data Analysis

A data set for 1972, 1976, and 1980 through 1985 is used to evaluate the effects of tenure on farm performance under various economic conditions in agriculture. The 1972 period was profitable for most farmers. It preceded the rapid inflation of land values and the rising interest rates of the late 1970s and early 1980s. By 1976, those economic events were well underway. By 1980 and 1981, values of U.S. farm land reached their peak and have since declined 29 percent nationwide (USDA 1986). Throughout the 1980s farm income has swung widely, although it remains low when measured in real terms. Thus, the data set represents considerable diversity in economic events for testing the relationship between farm tenure and business performance.

FBFM Data and Results

Approximately 8,000 farmers are enrolled in the Illinois FBFM system. It includes one of every five farms in Illinois over 500 acres.

Farmer's records are carefully screened and edited by professional field staff who certify approximately 4,000 farm records as usable for comparative analysis. The FBFM data are summarized at the individual operator level along with a total farm analysis. Included in the summary are cash sales and expenses along with inventory and accrual adjustments. Total farm investments for the operator and landlord are also reported.

Total farm investment consists of end-of-year values of crops, feed, machinery, buildings, and land. Crops and feed are inventoried at constant prices. Remaining cost values are used for machinery and buildings while land is valued on a current market basis with annual adjustments following the USDA land price index. No nonfarm assets, liabilities, or income are included.

Total debt is not available in the FBFM records; it is estimated here by capitalizing the interest paid on debt each year. Average interest rates paid by borrowers for real estate and nonreal estate debt were obtained from previous studies (Melichar; USDA 1984). The nonreal estate interest ranged from 7.5 percent in 1972 to 16.4 percent in 1981 to 11.5 percent in 1985. Average interest rates on farm real estate debt ranged from 5.9 percent in 1972 to 10.1 in 1983 to 9 percent in 1985. The estimated capitalization rate varied among farms depending on their asset structure. Each farm's rate is calculated by adding the products of the percent of nonreal estate assets times the interest rate paid on nonreal estate debt and the percent of real estate assets times the average interest rate paid on real estate debt. The validity of this method is tested later in the study.

The performance variables include solvency and profitability. Solvency is measured by the total debt-to-asset ratio, while profitability is measured by returns to assets and returns to equity. The rate of return to assets is calculated by dividing accrual net farm income (net of imputed labor and management charges) before interest payments by total assets. The return to equity is computed by dividing accrual net farm income by the estimated equity capital in the farm business. Liquidity ratios are difficult to estimate with the FBFM data and, thus, are excluded from the analysis. Farm size and

asset structure are also measured to account for possible relationships between size and tenure. Farm size is measured by total tillable acres operated and total farm assets owned by the farm operator.

Tenure is measured as the farm operator's investment in farm land divided by the value of real estate used in the operation. Thus, a 30 percent tenure ratio indicates that 30 percent of the value of farm land is owned by the operator; the remaining 70 percent of the land is owned by someone else. The tenure measure is a continuous variable; however, it is classified into discrete categories in this study with 20 percent intervals between the categories.

The tenure ratio is relatively constant over the time period. The mean tenancy ratio rose from 29 percent in 1972 to a high of 33 percent in 1980 and declined to 31 percent by 1985. The percentage of farms in the lower tenancy categories shifts towards more ownership from 1972 to 1985. In 1972, 39 percent of the farms were full tenants, while 25 percent of the farms were full tenants in 1985. Most of the shift occurs in the 1-20 percent and 21-40 percent tenure categories.

Table 1 summarizes the mean values of farm size in acres operated by tenure classification. Average farm size in acres is consistently larger in the 1-20 percent and 21-40 percent tenure classes and more than double the size of the full owner. However, differences in means across the rest of the size categories are relatively small.

Table 1 also summarizes the mean values for each performance measure by tenure classification for each year of the period. As expected, total assets increase as ownership increases. However, average total assets for the full owner are smaller than the 61-80 percent and 81-99 percent classes because farm size is smaller. Asset values peak in 1980 and 1981 and then decline in each tenure category.

Except for 1984, the FBFM data show the anticipated decline in rates of return on assets as ownership of land increases. In 1984, the pure tenant and the 41-60 percent tenancy categories did not follow the patterns of previous years. Moreover, the pure tenant farms show much more variability between years than the full owner. The pure tenant's returns to assets peak in 1972 at 26

percent but decline to .6 percent by 1984, while the full owners' returns to assets change from 6 percent to 1.1 percent over the same period. This relationship is expected because full tenants have lower total assets. Small shifts in the income stream should affect the returns-to-assets ratio more for the pure tenant than the full owner.

The rate of returns on equity follows a different pattern. In the more profitable farming years of 1972, 1976, and 1985, as the ratio of leased land to owned land increases, so does the return on equity. In the less prosperous years, the resulting values show no specific pattern. With two minor exceptions, as the percentage of land ownership increases, the mean debt-to-asset ratios decline in each year. Mean debt-to-asset ratios rise steadily from 1976 to 1985 with the ratios for the lower tenure groups increasing much more rapidly. The pure tenant's mean debt-to-asset ratio rises from .257 in 1976 to .62 in 1984, a 141 percent increase. Similarly, the debt-to-asset ratio or the full owner, while much lower than the tenant's, increases from .145 in 1976 to .221 in 1984, a 52 percent increase.

In 1985, FBFM initiated the certification of farmers' balance sheets for use in research. A balance sheet could be certified by the field staff upon completion of all appropriate financial information. The complete balance sheet information was available for 595 farms in 1985. The actual balance sheet data for those farms provide a check on the estimates of debt and leverage described above for the full set of FBFM farms.¹ Table 2 shows the

¹Using the smaller group of farms with complete balance sheet information reinforces the relationship from the large FBFM data set. Regression analysis shows that the liabilities estimated by capitalizing the interest paid are not significantly different from actual liabilities reported in 1985. The intercept is -\$7,124, which can be explained by the inclusion of accrued income taxes, accounts payable, and other miscellaneous liabilities that could not be estimated via the interest capitalization procedure. However, estimated asset values are much lower than actual assets reported. That is largely due to the reporting by the 600 farms of financial and nonfarm assets that are not available with the larger data bank. Another reason for the asset discrepancy involves the values of machinery and buildings. The complete balance sheet data show those items valued at their current market value, while the previous calculations use the remaining cost value.

Table 1. Mean Values of Characteristics: FBFM Cooperators By Tenure Classification

	Pure Tenant	1-20%	Tenure Classification				Full Owner	All Farms
			21-40%	41-60%	61-80%	81-99%		
<i>Acres Operated Per Farm</i>								
1985	541	706	695	601	521	543	294	596
1984	512	674	664	576	531	497	306	569
1983	511	671	659	589	482	593	313	567
1982	505	649	648	569	493	556	298	553
1981	490	649	621	566	468	481	293	536
1980	489	638	627	544	494	478	302	532
1976	446	623	580	503	450	395	278	487
1972	426	583	534	478	390	404	268	454
<i>Total Assets(\$)</i>								
1985	150,156	318,846	551,737	695,948	779,383	981,825	660,436	459,122
1984	137,756	310,610	564,158	705,151	856,426	965,760	726,360	470,493
1983	151,284	378,854	694,546	900,529	981,451	1,358,217	930,951	582,365
1982	160,671	397,485	761,615	966,606	1,075,059	1,417,761	973,870	620,151
1981	159,906	438,094	783,413	1,047,264	1,110,257	1,400,110	1,047,977	657,188
1980	166,191	432,958	773,728	976,690	1,157,897	1,392,749	1,083,326	659,664
1976	111,226	281,845	424,500	521,965	591,451	623,632	532,298	345,733
1972	50,789	127,999	193,426	251,727	269,656	335,466	252,032	149,041
<i>Rate of Return on Assets</i>								
1985	.126	.095	.051	.036	.034	.024	.019	.073
1984	.006	.032	.015	.011	.014	.013	.011	.016
1983	.058	.053	.023	.020	.017	.013	.013	.037
1982	.076	.056	.038	.029	.029	.027	.024	.049
1981	.027	.025	.020	.015	.011	.011	.008	.020
1980	.125	.070	.045	.038	.034	.032	.033	.068
1976	.209	.136	.087	.067	.056	.055	.036	.122
1972	.257	.184	.125	.098	.075	.074	.059	.171
<i>Rate of Return on Equity</i>								
1985	.103	.079	-.010	-.026	-.026	-.020	-.015	.035
1984	-.036	-.037	-.067	-.065	-.038	-.027	-.019	-.044
1983	.027	.007	-.044	-.029	-.026	-.022	-.015	-.011
1982	.036	.001	-.012	-.013	-.002	-.003	.001	.005
1981	-.030	-.029	-.024	-.019	-.018	-.030	-.013	-.025
1980	.125	.041	.023	.019	.019	.016	.019	.052
1976	.222	.148	.090	.060	.050	.050	.025	.125
1972	.309	.245	.156	.114	.080	.072	.056	.204
<i>Debt-to-Asset Ratio</i>								
1985	.534	.599	.519	.424	.379	.331	.262	.490
1984	.620	.546	.439	.378	.307	.254	.221	.451
1983	.592	.497	.370	.309	.256	.224	.194	.418
1982	.517	.431	.328	.266	.229	.200	.177	.367
1981	.358	.365	.266	.214	.187	.225	.172	.288
1980	.329	.314	.230	.193	.168	.162	.143	.257
1976	.257	.238	.207	.174	.152	.139	.145	.210
1972	.303	.294	.277	.239	.227	.198	.177	.270

Table 2. Mean Values of Characteristics: FBFM Cooperators by Tenure Classification, Sample Balance Sheet Farms, 1985

	Pure Tenant	1-20%	Tenure Classification				Full Owner	All Farms
			21-40%	41-60%	61-80%	81-99%		
<i>Number of Farms</i>	119	194	121	86	35	16	24	595
<i>Percent of Total Sample</i>	20%	32.6%	20.3%	14.5%	5.9%	2.7%	4%	100%
<i>Acres Operated</i>	542	681	702	628	519	514	359	623
<i>Debt-to-Asset Ratio</i>	.420	.454	.356	.320	.322	.196	.169	.382
<i>Return on Assets</i>	.070	.072	.047	.038	.039	.030	.021	.056
<i>Return on Equity</i>	.048	.064	.009	0	-.005	.001	-.01	.031

Table 3. Tukey-Kramer Mean Separation Tests 1985 FBFM Data Set^a

Sample Size	Mean Debt-to-Asset Ratio	Tenure Classification	Tenure Classification						Full Owner
			Pure Tenant	1-20%	21-40%	41-60%	61-80%	81-99%	
<i>Debt-to-Asset Ratio Means Test</i>									
815	.53	Pure Tenant	... NA	X		X	X	X	X
843	.60	1-20%	NA		X	X	X	X	X
665	.52	21-40%	NA			X	X	X	X
413	.42	41-60%	NA						X
245	.38	61-80%	NA				NA		X
103	.33	81-99%	NA					NA	
215	.26	Full Owner	NA						NA
<i>Return on Assets Means Test</i>									
	Mean Rate of Return on Assets								
	.126	Pure Tenant	... NA	X	X	X	X	X	X
	.095	1-20%	NA		X	X	X	X	X
	.051	21-40%	NA						
	.036	41-60%	NA						
	.034	61-80%	NA				NA		
	.024	81-99%	NA					NA	
	.019	Full Owner	NA						NA

^aX indicates Means are significantly different with a 95 percent confidence interval.

results for that group of farms. The distribution of farms among the tenure classes is similar to the total data set of FBFM farms. The average tenancy ratio is 27 percent for the certified group of farms compared with 31 percent for all FBFM farms. Moreover, the trends for that group of farms support the results obtained earlier. As the percentage of owned land decreases, the debt-to-asset ratio increases, farm size tends to increase, and the accounting rates of return on assets and equity tend to increase as well.

Further statistical tests support the results discussed above. A multiple comparison method is used to test the differences observed between the mean values. Tukey proposed a test for pairwise comparisons for equal sample sizes: Kramer and Tukey followed with a method for unequal sample sizes. Two means are considered significantly different by the Tukey-Kramer criterion if

$$|\bar{y}_i - \bar{y}_j| / s((1/n_i + 1/n_j)/2)^{1/2} > q(\alpha; k, \nu)$$

where $\bar{y}_i$ and $\bar{y}_j$ are the means, n_i and n_j are the number of observations in the two cells, s is the root mean square error, and $q(\alpha; k, \nu)$

is the α -level critical value of a studentized range distribution of k independent normal random variables with ν degrees of freedom. The method has been evaluated and is supported by previous Monte Carlo studies (Dunnett). It compares means between classes and indicates significant differences between mean values of each class.

Mean values for the debt-to-asset ratio and return on assets are tested for significant differences between tenure classes for each year studied, using a 95 percent confidence interval. The differences for 1985 are summarized in Table 3. The lower the ratio of owned land to leased land, the higher is the degree of significance of differences between classes. The pure tenant's mean debt-to-asset ratio is significantly different from each tenure class except the 21-40 percent class. The mean debt-to-asset ratio for 1-20 percent class is significantly different from all other tenure categories. The full owners' mean debt-to-asset ratio is significantly lower than all tenure classes except the 81-99 percent tenure class. Those patterns of significant differences are similar for each year except 1972 in which the debt-

to-asset means showed little significant difference between the tenure classes.²

Tests for differences in mean values for return on assets show slightly different results. The means of the return on assets for the pure tenant and 1-20 percent tenure classes are significantly different from each remaining tenure class. All other classes show no significant difference in the mean values of returns on assets at the 95 percent level. Those patterns of differences for return on assets are consistent for the more profitable farming years. In less prosperous years (1981-84) few of the tenure classes have significant differences between mean values for returns on assets.

Previous studies show that solvency and profitability differ across farm size (USDA 1985) due to the possible effects of economies or diseconomies of scale and other factors. The FBFM data show that tenure varies to some degree across farm size, so some of the relationships observed between tenure, profitability, and solvency may be due to size rather than land ownership. To test those effects our approach was to first formulate and estimate two models in which the debt-to-asset ratio and return to assets are functions of tenure, size, and interactions between size and tenure. If, as occurred, both size and tenure are significant, then the analysis is extended to remove the size effect by testing the relationship between tenure and the debt-to-asset ratio and tenure and returns to assets for farms falling within a set of stipulated size categories.

The regression models are estimated using continuous measures for the three variables under the 1985 conditions, and they yield the following results

$$D/A = 49.644 - 0.268 TEN + 0.013 ACRES - 0.000 TEN ACRES \\ (1.891)^* (0.024)^* (0.002)^* (0.000) \\ R^2 = 0.065 \quad (1)$$

$$RET = 7.762 - 0.066 TEN + 0.006 ACRES - 0.000 TEN ACRES \\ (0.969)^* (0.020)^* (0.001)^* (0.000) \\ R^2 = 0.037 \quad (2)$$

Standard errors are in parentheses; * indicates significant at 95 percent level

where D/A is the percentage of total debt to total assets, TEN is the percentage of owned land to total land operated, $ACRES$ is total acres of land operated, and RET is net farm income before interest payments expressed as a percentage of total assets owned by the farm operator. The results indicate significant relationships for each independent variable but not the interaction term at the 95 percent level.³ Similar to other cross-sectional studies, the resulting R^2 values are low. This implies that much of the variation in debt-to-asset ratio and return to assets can not be explained by farm size or tenure.

To control size, the 1985 data set is divided into eight groups of 100-acre increments. This categorization scheme is examined by using the regression models defined in equations 1 and 2, without an interaction term, and by estimating the significance of the size variable on the independent variable. The acres variable does not have significant coefficients within any of the subgroups at the 95 percent confidence level. Table 4 shows the mean results for each tenure classification within each acre subgroup. The same general trends tend to occur within each group. That is, the debt-to-asset and return-on-asset ratios decrease as the ownership of land increases, although the changes are more pronounced as one approaches the full owner category.

The Tukey-Kramer method is used to test the significance of the means of the debt-to-asset ratios and the rates of return to asset between tenure classes. Acre subgroups greater than 600 acres do not show any significant differences between the mean debt-to-asset ratios among tenure classifications at the 95 percent level. Table 5 shows the Tukey-Kramer results for farms less than 600 acres. The debt-to-asset ratio mean for the full owner tenure class is significantly different from the pure tenant and the 1-20 percent tenure classification for farms in each subgroup below 500 acres.

No significant differences in return-on-asset means result in farm sizes of 0 to 300 or 500

²Specific Tukey-Kramer hypothesized test results for each year studied are available from the authors.

³The $ACRES$ variable is significant at the 95 percent level in the debt-to-asset regression, equation 1, for each year analyzed with the FBFM and FCS data set. The $ACRES$ variable is significant in the return-to-asset regression, equation 2, in each year except 1980.

Table 4. Mean Values of Solvency and Profitability Measures: 1985 FBFM Cooperators By Size and Tenure Classification

	Pure Tenant	1-20%	Tenure Classification				Full Owners	All Farms
			21-40%	41-60%	61-80%	81-99%		
<i>Debt-to-Asset Ratio</i>								
acres ≤ 300	.43	.55	.41	.37	.32	.23	.25	.37
sample size	146	47	48	54	55	15	120	485
300 < acres ≤ 400	.43	.53	.44	.31	.28	.20	.22	.39
sample size	156	77	99	66	41	15	40	494
400 < acres ≤ 500	.58	.53	.46	.30	.34	.36	.24	.47
sample size	130	132	94	68	39	16	22	501
500 < acres ≤ 600	.53	.60	.56	.39	.34	.38	.35	.51
sample size	129	122	85	59	45	18	14	472
600 < acres ≤ 700	.56	.63	.48	.43	.53	.40	.28	.55
sample size	66	123	64	32	10	11	6	312
700 < acres ≤ 800	.66	.66	.55	.58	.39	.38	.34	.59
sample size	57	73	63	29	18	11	5	256
800 < acres ≤ 900	.62	.62	.54	.49	.41	.34	.17	.56
sample size	35	72	57	25	12	6	3	210
900 < acres ≤ 1000	.84	.73	.59	.54	.47	.33	.04	.64
sample size	16	56	33	27	8	6	2	148
1000 < acres	.55	.62	.59	.49	.52	.26	.31	.57
sample size	80	141	122	53	17	5	3	421
TOTAL SAMPLE SIZE	815	843	665	413	245	103	215	3,299
<i>Return on Assets</i>								
acres ≤ 300	0	.03	.02	.02	.01	-.03	.02	.01
sample size	146	47	48	54	55	15	120	485
300 < acres ≤ 400	.12	.06	.03	.02	.03	.03	.03	.06
sample size	156	77	99	66	41	15	40	494
400 < acres ≤ 500	.14	.08	.06	.03	.04	.05	.03	.08
sample size	130	132	94	68	39	16	22	501
500 < acres ≤ 600	.22	.11	.06	.03	.04	.02	.02	.11
sample size	129	122	85	59	45	18	14	472
600 < acres ≤ 700	.20	.11	.06	.05	.04	.04	.06	.11
sample size	66	123	64	32	10	11	6	312
700 < acres ≤ 800	.20	.11	.05	.04	.05	.02	.04	.10
sample size	57	73	63	29	18	11	5	256
800 < acres ≤ 900	.17	.13	.05	.05	.03	.05	-.05	.10
sample size	35	72	57	25	12	6	3	210
900 < acres ≤ 1000	.18	.11	.08	.07	.02	.04	0	.09
sample size	16	56	33	27	8	6	2	148
1000 < acres	.18	.11	.07	.05	.07	.03	.01	.10
sample size	80	141	122	53	17	5	3	421
TOTAL SAMPLE SIZE	815	843	665	413	245	103	215	3,299

Table 5. Tukey-Kramer Debt-to-Asset Ratio Mean Separation Tests by Acre Subgroups,^{a,b}FBFM Data Set, 1985

Sample Size	Mean Debt-to-Asset Ratio	Tenure Classification	Tenure Classification					Full Owner	
			Pure Tenant	1-20%	21-40%	41-60%	61-80%		81-99%
Debt-to-Asset Ratio Means Test 0-acre to 300-acre farms									
146	.43	Pure Tenant	...	NA					X
47	.55	1-20%	.....	NA					X
48	.41	21-40%	.....		NA				
54	.37	41-60%	.....			NA			
55	.32	61-80%	.....				NA		
15	.23	81-99%	.....					NA	
120	.25	Full Owner	.....						NA
300-acre to 400-acre farms									
156	.43	Pure Tenant	...	NA					X
77	.53	1-20%	.....	NA		X	X		X
99	.44	21-40%	.....		NA				X
66	.31	41-60%	.....			NA			
41	.28	61-80%	.....				NA		
15	.20	81-99%	.....					NA	
40	.22	Full Owner	.....						NA
400-acre to 500-acre farms									
130	.58	Pure Tenant	...	NA		X	X		X
132	.53	1-20%	.....	NA		X			X
94	.46	21-40%	.....		NA				
68	.30	41-60%	.....			NA			
39	.34	61-80%	.....				NA		
16	.36	81-99%	.....					NA	
22	.24	Full Owner	.....						NA
500-acre to 600-acre farms									
129	.53	Pure Tenant	...	NA					
122	.60	1-20%	.....	NA		X	X		
85	.56	21-40%	.....		NA				
59	.39	41-60%	.....			NA			
45	.34	61-80%	.....				NA		
18	.38	81-99%	.....					NA	
14	.35	Full Owner	.....						NA

^aX indicates Means are significantly different with a 95 percent confidence interval.

^bAcre subgroups greater than 600 acres do not show any differences in mean values between tenure classifications.

to 600 acres.⁴ In each of the other subgroups the mean rate of return on asset for the full tenant differs significantly from at least three of the six other tenure classifications. In the 400-500 acre and 700-800 acre subgroups the mean rate of return on assets for the full tenant differs significantly from the six other tenure classifications.

As shown by the Tukey-Kramer tests, the size categorization tends to reduce the incidence

and consistency of significant differences in mean values of profitability and solvency across the tenure categories. That may be due to the remaining influence of size; however, the small sample sizes within the acre subgroups are a factor as well. To further test the relationship of tenure on profitability and solvency, we estimate regression equations at each size interval. The proportion of owned land to total land operated is the independent variable in each equation. Returns-to-assets and debt-to-asset ratio, respectively, are the dependent variables. In 1985, when the debt-to-asset ratio is regressed on the tenure variable, the

⁴Specific Tukey-Kramer hypothesized test results for specific acre subgroups for 1985 are available from the authors.

tenure variable is significantly different from zero at the 95 percent level in all eight size groups, while the tenure variable is significant at the 95 percent confidence level in seven of the eight categories when regressed with returns to assets. Only for farms below 300 acres is the tenure variable not significant. In all cases, the coefficients are negative indicating as the proportion of owned land to total land decreases, rates of returns on assets and debt-to-asset ratios increase. In 1984, the tenure variable coefficient is significantly different from zero in seven of the eight size categories when regressed against the debt-to-asset ratio. The tenure variable is significantly different from zero at the 95 percent confidence level in five of eight size categories when regressed against rate of return on assets. The results indicate that differences observed in performance measures across tenure categories still hold when farm size is controlled.

FCB Data and Results

The FCB data include data on all new Federal Land Bank (FLB) loans made in Illinois for 1976 and for 1980 through 1984.^{5,6} Only loans made to farms over 250 acres in size are considered. Because the majority of FLB loans are for farm real estate purposes, no substantial data are available for the pure tenant category. Financial statements completed after September are included in the following year's summary. No profitability data are included in the FCB records.

⁵The differences in the data sources should be clarified to avoid any misinterpretation of the results. About 95 percent of the FBFM farms are enrolled in the service from year to year; therefore relative consistency in the data set is maintained. The FLB data are only for new loans made in the current year. All FBFM data are summarized at the end of the calendar year, while FLB data are taken when the real estate loan is made. Asset values assigned to the FLB data are at the discretion of the loan officer, while FBFM maintains consistent valuation procedures for land and crop inventories. Machinery reported with the FLB data is valued at current market value, while FBFM uses remaining cost values. Nonfarm assets and liabilities are included with all FLB data, while FBFM data include only farm assets. Liability data are taken directly from the FLB records, while they are estimated for FBFM by capitalizing the farmer's interest paid. Finally, FCB lending policies determine the actual loans made and, thus, influence the resulting financial measures of those farmers.

⁶1972 will not be summarized with the FCB data due to differences of reporting values in subsequent years.

Average tenure for the FCB data as measured by acres owned divided by total acres farmed ranges from 55 percent in 1976 to 59 percent in 1984. Farms in the 1-60 percent tenure classifications make up 53 percent of the farms, while 27 percent are full owners. In each year more than 20 percent of the farms are full owners.

Similar to the FBFM results, average farm size as measured by acres operated generally decreases as ownership increases. The mean values of farm size by tenure classification are shown in Table 6. In 1984, the mean farm sizes are 900 acres for the 1-20 percent tenure category and 533 acres for full owners. Except for 1976, the pattern is constant throughout the time period. Average farm size on all farms decreases slightly over the time period.

Similar to the FBFM data, the debt-to-asset ratio declines with increases in the ratio of land owned to total land operated. In 1984, the mean debt-to-asset ratios are .35 for farms in the 1-20 percent tenure category and .21 for full owners. In 1980, those ratios are .37 and .24, respectively. The ratio decreases as ownership increases in each of the years except 1976. In contrast to national data and the FBFM data, the mean debt-to-asset ratios for all farms in the FLB data set decline over the time period. The reasons for the decline are unknown, although it could reflect a more conservative response by the FLB or by borrowers to the deteriorating financial conditions in agriculture.

The Tukey-Kramer method again is used to test the significance of differences in the means for the debt-to-asset ratio between tenure classes. Table 7 shows the Tukey-Kramer results for 1984 and 1981. Significant differences between the mean debt-to-asset ratios occur primarily at higher percentages of owned land to leased land. In 1984, the mean debt-to-asset ratio for the full owner is significantly different from all other tenure classes except the 81-99 percent tenure class. The 81-99 percent class differs significantly from the 1-21 percent, 21-40 percent, and 41-60 percent tenure ratio classifications. Significant differences between mean debt-to-asset ratios by tenure class are more strongly supported with the FCB data in years prior to 1984. In 1981, only three out of a possible fifteen paired debt-to-

Table 6. Mean Values of Characteristics: FLB Borrowers by Tenure Classification

	Pure Tenant	1-20%	21-40%	Tenure Classification			Full Owner	All Farms
				41-60%	61-80%	81-99%		
<i>Acres Operated Per Farm</i>								
1984	NA	900	916	842	816	923	533	784
1983	NA	980	951	868	971	814	556	829
1982	NA	955	904	805	839	788	697	809
1981	NA	899	907	871	766	865	596	802
1980	NA	908	966	875	769	833	656	833
1976	NA	828	976	936	831	779	822	845
<i>Total Assets Owned (\$)</i>								
1984	NA	618,343	931,814	1,190,092	1,511,332	2,983,823	1,470,994	1,294,335
1983	NA	631,665	1,062,982	1,327,899	1,865,987	2,421,969	1,920,722	1,462,195
1982	NA	641,972	1,075,362	1,221,987	1,676,005	1,806,332	2,261,153	1,426,777
1981	NA	670,836	1,194,019	1,550,090	1,707,990	2,139,176	2,045,810	1,489,615
1980	NA	677,493	1,233,445	1,527,464	1,716,007	2,281,963	2,487,608	1,581,911
1976	NA	437,721	803,818	1,242,165	1,412,867	1,566,106	2,554,868	1,337,890
<i>Debt-to-Asset Ratio</i>								
1984	NA	.35	.33	.33	.31	.24	.21	.29
1983	NA	.38	.33	.29	.30	.23	.23	.29
1982	NA	.36	.33	.29	.29	.28	.22	.29
1981	NA	.38	.31	.29	.25	.25	.22	.29
1980	NA	.37	.34	.29	.28	.27	.24	.30
1976	NA	.44	.38	.35	.32	.34	.39	.35

Table 7. Tukey-Kramer Debt-to-Asset Ratio Mean Separation Tests, FCB Data Set, 1984 and 1981^a

Sample Size	Mean Debt-to-Asset Ratio	Tenure Classification	Tenure Classification					Full Owner
			1-20%	21-40%	41-60%	61-80%	81-99%	
1984 Debt-to-Asset Ratio Mean Test								
84	.35	1-20%	 NA				X	X
140	.33	21-40%	 NA				X	X
116	.33	41-60%	 NA				X	X
77	.31	61-80%	 NA					X
44	.24	81-99%	 NA				NA	
170	.21	Full Owner	.....					NA
1981 Debt-to-Asset Mean Ratio Test								
368	.38	1-20%	 NA	X	X	X	X	X
409	.31	21-40%	 NA			X	X	X
358	.29	41-60%	 NA			X	X	X
268	.25	61-80%	 NA			NA		X
139	.25	81-99%	 NA				NA	
479	.22	Full Owner	.....					NA

^aX indicates Means are significantly different with a 95 percent confidence interval.

asset ratio means are not significantly different between tenure ratio classifications.

Financial Simulation Analysis

Another objective of this study is to simulate the future performance of farm businesses

with different tenure positions. The model farm in this study is a typical, central Illinois cash grain farm. Structural characteristics and production values are taken from the FBFM data. Projected estimates of commodity prices, rates of change in input costs, and interest rates on farm loans were obtained

from a macroeconomic model of the U.S. farm sector formulated by FAPRI at the University of Missouri (Barry).

The base farm is a 640-acre unit producing corn (60 percent) and soybeans (40 percent). The average yields are 135 bushels per acre for corn and 45 bushels per acre for soybeans. The farm operator participates in the government feed grain program, which decreases corn acreage by 20 percent. Growth rates for most costs of production, machinery values, and other items range from 1 percent to 5 percent per year. The commodity prices and interest rates on financial assets are as follows:

	<i>Year 1</i>	<i>Year 2</i>	<i>Year 3</i>	<i>Year 4</i>
Corn (\$/bu.)	1.99	1.94	1.96	1.96
Soybeans (\$/bu.)	4.86	4.99	5.05	5.05
Interest on Debt	12.1%	12.3%	12.3%	12.5%
Marketable Securities	6.8%	7.5%	8.4%	8.7%

Land is valued at \$1,500 per acre, and it remains constant over the four-year period. The beginning financial structure of each farm is represented by three levels of its debt-to-asset ratio: 20 percent for the low-leverage case, 40 percent for the medium-leverage case, and 70 percent for the high-leverage case. Rented land is leased on a fifty-fifty crop share lease. Tenure is adjusted in 10 percent increments by

increasing the land owned and decreasing the leased land. Only real estate taxes, principal, and interest obligations change as tenure changes.

A farm-level simulation model is used to conduct the financial analysis (Schnitkey, Barry, and Ellinger). The microcomputer-based model simulates the financial structure of a farm over a four-year period. Although the model allows considerable production detail, the major emphasis is on the financial components (that is, capital transactions, refinancing options, changes in costs and prices, and asset valuation changes). The results are summarized in a set of coordinated financial reports based on equations linking the production, financing, tax, and consumption activities. The 1986 tax changes are incorporated in the tax activity section.

Simulation Results

Results for the simulation runs are summarized in Table 8. Financial performance measures reported are net income, debt-to-asset ratio, return on assets, and return on equity. Net income includes net farm income plus any interest income. Returns are calculated after capital asset adjustments for gains or losses. All results are summarized for each leverage position at the end of year four.

Table 8. Simulation Responses of Profitability and Solvency to Various Tenure Relationships

	Pure Tenant	10%	20%	30%	Tenure Classification						Full Owner
					40%	50%	60%	70%	80%	90%	
<i>Net Income</i>											
20% D/A	14,378	16,709	18,614	20,527	22,507	24,487	26,452	28,340	30,209	32,003	33,805
40% D/A	9,821	9,301	8,780	8,258	7,737	7,216	6,694	6,173	5,630	5,036	4,442
70% D/A	2,295	(3,642)	(9,695)	(15,774)	(21,948)	(28,175)	(34,403)	(40,630)	(46,858)	(53,086)	(59,315)
<i>Debt-to-Asset Ratio</i>											
20% D/A	.393	.289	.244	.218	.201	.190	.182	.179	.177	.177	.177
40% D/A	.664	.567	.523	.498	.482	.471	.463	.457	.452	.448	.445
70% D/A	1.079	1.000	.967	.949	.939	.933	.928	.924	.922	.919	.917
<i>Return on Assets</i>											
20% D/A	.159	.114	.093	.080	.073	.067	.063	.060	.058	.056	.054
40% D/A	.162	.117	.097	.085	.078	.073	.069	.066	.063	.062	.060
70% D/A	.164	.118	.097	.085	.078	.072	.068	.065	.063	.061	.060
<i>Return on Equity</i>											
20% D/A	.166	.105	.080	.066	.058	.053	.049	.045	.043	.041	.039
40% D/A	.193	.100	.066	.048	.037	.030	.024	.020	.017	.014	.012
70% D/A	NA ^a	NA	-.130	-.189	-.225	-.251	-.269	-.282	-.293	-.301	-.308

^aNA = Farm was technically insolvent at the end of simulation.

The simulation results show some interesting interrelationships between the model farm's tenure and leverage positions. For the 20 percent debt-to-asset leverage position, net income increases as land ownership increases. For the 40 percent and 70 percent debt-to-asset positions, net income declines from \$2,000 for pure tenant to \$(60,000) for full owner. Ending debt-to-asset ratios are consistently lower over all the leverage classes as land ownership increases. Rates of return on equity and assets are consistently higher for the pure tenants than for full owners and increase steadily as the ratio of owned land to leased land declines. The differences become more substantial as leverage increases.

The simulated results help to verify the empirical evidence that farm operators with higher ratios of leased to owned land have higher accounting returns as well as higher leverage positions, even after accounting for differences in farm size. Rates of return are consistently higher for operators with a higher percentage of leased to owned land. As the beginning debt-to-asset ratio increases from 20 percent to 40 percent and 70 percent, income levels show fewer fluctuations for farms with lower ownership of land than for farms with higher ownership. This may indicate that farm operators with a higher ratio of leased land to owned land can operate at higher leverage positions.

Concluding Comments

The empirical evidence, including both actual and simulated relationships between tenure and financial performance, is consistent with expected relationships; that is, higher ownership in land is associated with lower accounting rates of return and lower leverage positions. As tenancy increases, rates of return to assets and leverage positions are consistently higher. Rates of return to equity follow similar patterns in profitable farming years. As shown, part of the relationship between tenure and financial performance may be due to farm size. As tenancy increases, farm size as measured by acres also increases. Further analysis shows that relationships between tenure and financial performance remain consistent with expected results even as size is controlled.

With both FBFM and FLB data sources, debt-to-asset ratios decline as the ratio of owned land to total land increases. Much emphasis has been put on the debt-to-asset ratio and the estimation of threshold levels of indebtedness. However, the results of this study indicate that the tenure position should be considered along with the debt-to-asset ratio to determine whether a farm may be below or above a typical norm. The 40 percent debt-to-asset ratio, which has been used by the USDA and others as a threshold to financial stress, may be closer to the norm for the pure tenant while it represents more than average debt for the full owner.

This paper shows the relationships between tenure position and key financial performance measures for farm businesses, and it shows the consistency of those relationships over time. Much attention has been given to specific performance measures on an aggregate basis, but little has been said about defining ranges or norms for farms with different structural characteristics. What may seem typical or below average on an aggregate basis may be misleading when comparing farms that have different tenure positions. Moreover, future research could consider the combined effects of other structural variables as well.

References

- Barry, Peter J. *Financial Stress in Agriculture: Policy and Financial Consequences* AE-4621. Department of Agricultural Economics, University of Illinois, November 1986.
- Barry, Peter J., and Lindon J. Robison. "Economics Versus Accounting Rates of Return for Farm Land." *Land Economics* 62 (November 1986):388-401.
- Dunnett, C.W. "Pairwise Multiple Comparisons Suggested in the Homogeneous Variance, Unequal Sample Size Case." *J. of the Amer. Statistical Association* 75 (1980):371-72.
- Food and Agricultural Policy Research Institute. *Summary Report: Economy-Wide Impacts of the Farm Financial Crisis*. FAPRI Report #9-85. Iowa State University, July 1985.
- Jolly, Robert W., and Damona Doye. *Farm Income and the Financial Condition of United States Agriculture*. FAPRI Report #8-85. Iowa State University, July 1985.

Kramer, C.Y. "Extension of Multiple Range Tests to Group Means with Unequal Number of Replications." *Biometrics* 12(1956):307-10.

Melichar, Emanuel. *Agricultural Finance Databook-Quarterly Series*. Statistical release E.15. Division of Research and Statistics, Board of Governors of the Federal Reserve System, July 1985.

Schnitkey, Gary D., Peter J. Barry, and Paul N. Ellinger. *The Farm Financial Simulation Model: Documentation and User Guidelines*. 86-E363. Department of Agricultural Economics, University of Illinois, 1986.

Scott, John T., Jr. "Changes in Capital and Income Relationships." *N. C. J. of Agr. Econ.* 5(July 1983):27-37.

Tukey, J.W. "The Problem of Multiple Comparisons." Unpublished manuscript, 1953.

U.S. Department of Agriculture, Economic Research Service. *Agricultural Resources: Land Values and Markets*. June 1986.

_____. *Financial Characteristics of U.S. Farms, January 1985*. AIB 495, July 1985.

_____. *Agricultural Statistics, 1984*. December 1984.

Effects of Market Channels on Prices of Farm Land in South Carolina

C. Stassen Thompson and William S. Whiteside

Abstract

The primary method of selling farm land in South Carolina is by private treaty. Sales by private treaty account for 62 percent of land transfers. Real estate firms account for 19 percent of the sales with auctions and family transfers accounting for the remainder. Market services vary with the method of transfer. Real estate firms provide a full array of marketing services. Empirical evidence from South Carolina indicates the price of farm land varies among the method of transfer with land marketed by real estate firms averaging \$102 more per acre than land privately sold.

Key words: farm land prices, market channels, market services, private treaty, real estate firms, auctions, family transfers.

Land is not a homogeneous product. Zoning, road network, proximity to cities, lakes, markets, and inherent soil characteristics all contribute to the heterogeneous nature of land. Effects of those factors on farm land prices have been the focus of numerous studies. Another factor contributing to this heterogeneity is how the real estate is marketed. Farm land is transferred by private treaty, family transfer, sales through auction, sales through real estate firm, or by trading (Uchtmann; Healy and Short). Information and services associated with market channels will differ and may affect price.

The purposes of the study reported in this paper are to (a) determine if prices paid for farm land differ for transfer through real estate firms as compared with private treaty and other methods of land transfer and (b) determine whether the buyer or the seller bears the cost of the commission charged by real estate firms.

In the following section market channels and market services for farm land are discussed. The next section is devoted to the development of a theoretical model. An empirical model is then fit with survey data from South Carolina. Model results are presented followed by implications and a summary.

Market Channels

Market institutions for most agricultural products have been explored in depth. Marketing functions fall into three major categories: (a) exchange, (b) physical supply, and (c) facilitating or other functions (Taylor and Shaw). The functions of exchange and physical supply create ownership, place, and form utility. Facilitating and other functions including pricing, financing, bearing risk, and providing market information, make the exchange and physical functions possible.

The authors are, respectively, professor and former research assistant, Department of Agricultural Economics and Rural Sociology, Clemson University. The authors gratefully acknowledge helpful comments of anonymous reviewers.

Most commodities undergo extensive processing that involves all three marketing functions before they reach the buyer. However, that is generally not the case with farm land (Breimyer). There is no central institution for the land market. Unlike farm commodities, land is not moved through a large network of "market stages" before reaching the buyer (Healy and Short). The real estate market deals mainly with the buying and selling of land resources that are developed and brought into use (Barlowe). The exchange of farm land is usually from the owner (seller) to buyer and does not necessitate the succession of intermediate owners found with most other products. Similarly, changes in place, time, and form utilities associated with typical physical supply functions are not involved in most farm land transfers; farm land in transition to other uses is the exception.

Most marketing services applicable to farm land transfers are facilitating functions. Those functions include appraising the property, advertising the property, showing the property, developing marketing strategies, providing information on farm land sales and general farm land market conditions, arranging financing, and providing for a timely sale of the property.

Some of the services benefit the buyer and some benefit the seller. The services vary among the four principal ways land is transferred, and the extent to which they are performed affects marketing costs. Further, the extent to which they are provided defines uniquely different products. Land sales that involve all the services are not the same product as land sales that involve only a few of the services.

Real estate firms normally provide most, if not all, of the services and charge a commission for the services. Commissions of up to 10 percent of the gross sale price, payable by the seller, are not uncommon.

Facilitating functions performed by auctions are similar to those performed by real estate firms. One of the main functions of auctions is to sell the property in a relatively short time. Commissions for auctions are similar to those for real estate firms.

Private treaty sales typically involve limited marketing services. Under that arrangement

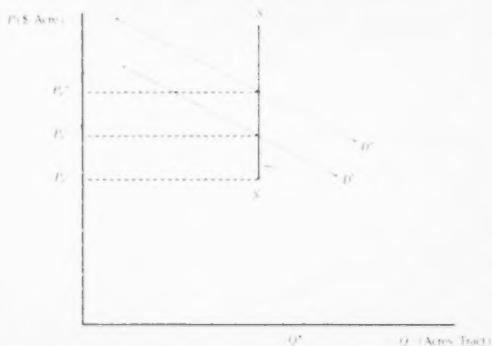
landowners assume the responsibility and the expense of any services. Avoiding the cost of the commission is a motivating factor for private sales.

Family transfers may or may not involve any marketing services. Gifts and inheritance of property normally would not. However, the settlement of an estate may necessitate an appraisal.

Theoretical Model

The relationship between the demand for land and for marketing services is illustrated in Figure 1 in a supply-demand framework. Discussion and conclusions for sales by private treaty and through real estate firms may be extended to auctions and family transfers.

Figure 1. Alternative Demand Curves For Land and Marketing Services



The supply curve for land is represented by SS . For simplicity assume that the only consideration is the sale of the entire tract. At a price equal to or greater than P_R , the reservation price, the owner will sell. Assume there are no marketing services associated with P_R . Costs normally incurred by the seller would include surveying costs or costs of providing a plat, legal costs incurred in the transfer, and opportunity costs of the owner's time. If the owner provides marketing services such as advertising and showing the property, the reservation price would increase by an amount equal to the costs of those services, including opportunity costs for his time and entrepreneurial incentives. If the owner marketed the land through a real estate firm, then the reservation price would

increase by an amount equal to the commission.

Demand curves for the land and various marketing services are also depicted in Figure 1. For simplicity, the demand curves are shown as linear, parallel, and on the same graph, even though the "final product," farm land and marketing services, differs amongst the demand curves.

Demand curve D'' represents the demand curve for farm land and those services provided by real estate firms. That is, the buyer desires the appraisal, information on other sales, screening of properties, showing of the property, assistance with financing, and other services provided by real estate firms. The equilibrium price for that final product is defined as P_R'' . If P_R'' is equal to or greater than the owner's reservation price associated with the sale through a real estate firm, then a transaction will occur.

Demand curve D' represents the demand curve for farm land and a more limited (compared with real estate firms) complement of services. Consider the marketing services provided by owners marketing the property themselves. If the equilibrium price, P_R' , is greater than or equal to the owner's reservation price associated with the services provided, then the property will sell. The lower price, P_R , may be considered as the price necessary for the sale of the land with no marketing services provided.

Assuming P_R'' represents the seller's reservation price for land marketed through a real estate firm, all of the commission is passed on to the buyer at a price equal to or greater than P_R'' . Acceptance of a price lower than P_R'' results in the seller paying part of the commission, which is tantamount to the seller lowering his reservation price. If private treaty sales involve some marketing services such as advertising, showing the property, and so forth, then sellers may be better off by selling through a real estate firm, depending on the relationship between P_R'' and P_R' .

Empirical Model and Data

Conceptually the price of farm land is expected to differ among the various market

channels. For a parcel of land, price is expected to be positively related to marketing services, other things equal. To test this hypothesis we estimate the following single equation model

$$Y_j = B_{0j} + \sum_{i=1}^9 B_{ij} X_{ij} + e_j \quad j = 1, 2$$

where

- Y_1 = price paid per acre of farm land,
- Y_2 = .9 Y_1 for sales through real estate firms and is equal to Y_1 for all other sales,
- X_1 = 1 if sale was by private treaty, zero otherwise,
- X_2 = 1 if sale was by family transfer, zero otherwise,
- X_3 = 1 if sale was by auction, zero otherwise,
- X_4 = the presence ($X_4 = 1$) or absence ($X_4 = 0$) of city or county water,
- X_5 = natural log of acres in tract,
- X_6 = appraised agricultural use value of property per acre (Source: South Carolina Tax Commission),
- X_7 = population density per square mile for the county and year in which sale occurred (Source: South Carolina Statistical Abstract),
- X_8 = ratio of appraised agricultural use value to actual market value (Source: South Carolina Tax Commission),
- X_9 = value of improvements per acre, in dollars (Source: South Carolina Tax Commission),
- e = error term.

Real estate firms are not explicitly accounted for in the model. Sales through real estate firms is the reference market channel and is represented by zero for X_1 , X_2 , and X_3 .

The model is estimated with observations on farm land sales from South Carolina. A list of buyers of agricultural land was obtained from the South Carolina Tax Commission for the years 1982–83. From the list a random sample of 500 buyers was drawn and weighted in proportion to the number of transactions reported in each county. Completed results were obtained on 300 transactions. No forced sales are included. The sales are distributed fairly evenly among counties relative to the total number of transactions. Sales are evenly distributed between the two years, 53 percent in 1982

and 47 percent in 1983. The sales are distributed among the market channels as follows: 62 percent by private treaty; 19 percent through real estate firms; 11 percent by family transfer, all of which involved remuneration; and 8 percent by auction.

Given the objectives of the study it is necessary to consider two alternative models. The only difference between the models is in the dependent variable. Model Y_1 allows for comparisons of prices among the various market channels. The comparison of prices, after sales through real estate firms are adjusted for commissions, may be made with Y_2 as the dependent variable. Each of the independent variables is discussed in turn. The variables are relevant for inclusion in both models. With the exception of market channel variables, signs on the coefficients are not expected to differ between the two models. However, magnitudes of the coefficients are expected to differ.

Based on the conceptual discussion, the price of farm land sold through real estate firms is expected to be greater than the price of farm land sold by either private sale or family transfer. Prices of farm land sold through auctions is not expected to be significantly different from prices of farm land sold through real estate firms. Thus, the coefficients on X_1 and X_2 are expected to be negative and significant in the model with Y_1 as the dependent variable and not significantly different from zero in the estimate with Y_2 as the dependent variable. The coefficient on X_3 is not expected to be statistically significant in either case.

Water availability affects the uses to which farm land can be put. Water availability also increases with proximity to cities. For these reasons, water availability, X_4 , is included and is believed to have a positive influence on price.

The per acre price of farm land is expected to vary inversely with the size of the tract, X_5 . Small tracts of farm land have more potential buyers and prices are bid up as a result of competition among the would be buyers (Duncan; Reiss and Kensil).

In South Carolina, tax appraisers quantify the agricultural use value of farm land for tax purposes. The variable, X_6 agricultural use

value, is included in the model to account for variation in farm land prices due to variations in quality and, thus, agricultural income-producing ability.

Population density, X_7 , has a direct effect on the demand for farm land. Increases in population is expected to result in an increase in demand for agricultural land for nonagricultural uses; for example, the additional need for houses, industrial sites, transportation systems, and shopping centers. Inclusion of population density accounts for locational differences throughout the state and is not parcel specific.

Variable X_8 , ratio of the agricultural use value to the appraised market value, measures the impact nonagricultural demand has on price and is parcel specific. An increase in the ratio reflects relatively fewer nonagricultural uses. As alternative uses of a property decrease, demand for the property decreases, and a negative effect on price is expected.

Table 1. Regression Results for Models of Farm Land Prices, South Carolina, 1982-83

Variable	Dependent Variables	
	Y_1	Y_2
	Estimated Coefficient	
Constant	1212.78	1092.31
X_1 (Private)	-102.45*	46.53
	(1.79) ^a	(.4)
X_2 (Family)	-202.87*	-57.75
	(2.4)	(.7)
X_3 (Auctions)	-68.63	82.53
	(.78)	(.33)
X_4 (Water)	-92.37***	102.24**
	(1.86)	(2.12)
X_5 (Acres)	-87.89**	-87.37**
	(4.82)	(4.92)
X_6 (App-Use)	.06**	.09**
	(2.84)	(4.08)
X_7 (Population)	1.39**	1.2**
	(4.46)	(3.96)
X_8 (Use/Market)	-.54**	-.73**
	(3.18)	(4.41)
X_9 (Improvements)	.96**	.9**
	(48.72)	(47.01)
R^2	.94	.94
F	517.91*	490.28*

^aNumbers in parentheses are the *t* ratios.

*Significant at the 5 percent probability level, one tail test.

**Significant at the 5 percent probability level, two tail test.

***Significant at the 10 percent probability level, two tail test.

Variable X_9 measures the per acre contribution of capital improvements to the purchase price of farm land. Increases in the dollar value of improvements are expected to have a positive effect on price.

Results

Model results with Y_1 and Y_2 as dependent variables are summarized in Table 1. Looking first at Y_1 , it can be seen that prices vary among the market channels. Private treaty sales are \$102.45 less per acre than sales through real estate firms. Because prices for those sales are hypothesized to be less than prices of real estate firms, the one tail test is the appropriate test. The difference is significant at the 5 percent probability level.

Land purchased through family transfer sells for \$202.87 per acre less than land sold through real estate firms. That coefficient is significant at the 1 percent probability level. Prices of land marketed through auctions are not different from land marketed by real estate firms at the 10 percent probability level. Thus the price of such land is not significantly different from the price of land sold through real estate firms.

As expected, property with city or county water sells for more than property without such water. The \$92.37 per acre contribution of city or county water to land value, estimated from the data, is significant at the 10 percent probability level.

The coefficients for all the remaining variables had the expected sign and were statistically significant. As expected there is a nonlinear relationship between size of tract and purchase price per acre. Appraised agricultural use value and population density as a measure of nonagricultural demand have positive effects on price. The coefficient for agricultural use value is low, this is likely due to the strong correlation between this variable and X_8 , ratio of appraised market to appraised use value. The sign for the variable X_8 is negative, as expected. As the number of alternative uses decreases, the price paid for land decreases. The value of capital improvements, as expected, has a positive effect on the purchase price of farm land. For every dollar of capital improvements per acre the purchase price increases by 96 cents.

However the coefficient is not different from 1 at the 5 percent probability level.

Model results with Y_2 as the dependent variable show that prices of farm land marketed by private treaty, family transfer, and through auctions are not different from the commission adjusted prices of farm land sold through real estate firms. Conclusions about the remaining variables remain unchanged.

Implications and Summary

Farm land may be marketed through four basic market channels: private treaty, family transfer, auctions, and real estate firms. Marketing services associated with farm land are not the same for land marketed through those various channels. The most extensive, and thus costly, marketing services are associated with real estate firms and auctions. Using data on farm land transactions in South Carolina, prices of farm land sold through real estate firms are shown to be higher than prices of farm land sold by private treaty and family transfer.

The results hold important implications for lenders, appraisers, researchers, and others dealing with farm land prices. From a research standpoint, failure to account for this variable could lead to spurious conclusions. Given the time series, cross-sectional nature of most farm land price studies, the omission of a relevant variable is not easily detected.

The results also have important implications for appraisers and lenders as well. Loan value is usually based on appraised market values. Appraisers are quick to exclude family transfers from their comparable sales analysis to avoid biases. Based on these results, failure to account for private versus real estate firm or auction sales could lead to biased estimates as well.

Are individuals "better off" by using a real estate firm to market their farm land? Results indicate that there is no difference in prices for private treaty sales and prices adjusted for the real estate commission. If individuals selling by private treaty do not incur any expenses for marketing services, including opportunity cost of their time, then there is no benefit to be derived by selling through a

real estate firm. However, if expenses are incurred they may be better off selling through a real estate firm depending on the extent of the expenses. Before drawing such conclusions, other factors, such as length of time to sell the property, should be considered.

References

Barlowe, Raleigh, *Land Resource Economics*. Englewood Cliffs, NJ: Prentice-Hall, 1987.

Breimyer, Harold F. *Economics of the Product Markets of Agriculture*. Ames: Iowa State University Press, 1976.

Duncan, Marvin. "Farm Real Estate Values—Some Important Determinants." *Monthly Review* Federal Reserve Bank of Kansas City, March 1977, 3–12.

Healy, Robert G., and James L. Short. *The Market for Rural Land Trends, Issues, Policies*. Washington, D.C.: The Conservation Foundation, 1981.

Reiss, Franklin J., and D.R. Kensil. *The Farmland Market in Ten Counties of Western Illinois*. Agricultural Experiment Station AERR 162. University of Illinois, February 1979.

South Carolina Division of Research and Statistical Services. *South Carolina Statistical Abstract 1986*.

Taylor, Weldon J., and R.T. Shaw, Jr. *Marketing: an Integrated Analytical Approach*. 2d ed. Cincinnati: Southwestern Publishing Company, 1969.

Uchtmann, Donald L. "Land Sale Methods." *Farm Real Estate*. North-Central Regional Extension publication no. 51. University of Illinois, 1979, 31–34.

Measuring Federal Farm Credit Subsidies

Dean W. Hughes and Nancy K. Osborn

Abstract

This paper updates and extends previous work done in measuring the magnitude of government interventions in farm credit markets. Federal farm credit subsidies are measured for real estate and nonreal estate debt and are found to be significant. Holding all else the same, farmers paid an average of \$544 million less in interest on real estate debt and \$1.4 billion less in interest on nonreal estate debt in the 1978 through 1985 period than they would have paid without the Farmers Home Administration (FmHA) and agency status for the Farm Credit System (FCS).

Key words: farm credit, government involvement in agriculture, farm credit policy, farm policy, Farm Credit System, Farmers Home Administration, agricultural finance

This paper describes the results of measuring the credit subsidies received by farmers through loans made by the FmHA and the FCS from 1978 through 1985. Past studies by the Office of the U.S. Comptroller General, Weidenbaum, and Lieblich were all done before the extent of the farm financial crisis was measurable. The studies, therefore, were not able to capture a major component of farm credit subsidies. And, as will be discussed later, the approaches taken by past studies have had the tendency to overstate subsidies from the FCS and understate those from FmHA (Hughes, et al., 1984).

There are two purposes served in measuring the size of credit subsidies to farmers. First, the process answers an interesting question in its own right by identifying how large government involvement has been in farm credit markets, in both absolute and relative terms. Second, measuring credit subsidies plays an important role in starting to answer the larger question: Who has benefitted from or been hurt by government involvement in farm credit markets? This study identifies the levels of government actions that created federal farm credit subsidies during the study period but does not attempt to identify all of the many influences the subsidies ultimately have had throughout the economy. For example, funding farm credit subsidies has generated increased levels of government debts. Although the increases in government debt are part of this study, no attempt is made to identify how much debt private lenders may have provided in the absence of government programs. This approach separates measurement from analysis and provides a common starting point for the multitude of possible interpretations of the eventual impacts of government subsidies.

The paper focuses on the subsidies provided by the FmHA and the FCS for several reasons. FmHA is the principal source of

Dean W. Hughes is an associate professor of agricultural economics and director of the Thornton Agricultural Finance Institute, and Nancy K. Osborn is a research assistant in the Department of Agricultural Economics, both at Texas Tech University. Funding for this project was provided by Thornton Agricultural Finance Institute, the Dean's Office of the College of Agricultural Sciences at Texas Tech University, and the U.S. Department of Agriculture through cooperative agreement number 58-3J23-4-00161. Texas Tech University, College of Agricultural Sciences publication number T-9-250.

direct government involvement in farm credit markets. The FCS is the largest lender to the farm sector and passes the benefits of its government agency status on to its member-borrowers in the form of lower interest rates on loans. Certainly, groups other than FmHA and the FCS transfer government subsidies to farmers. Some even have direct influences on farm credit markets, such as the Commodity Credit Corporation's (CCC) commodity loan programs, the Small Business Administration's (SBA) farm loans, and state farm credit programs. The intent of CCC loans has normally been to stabilize farm commodity prices and farm incomes, not necessarily to change conditions in farm credit markets. SBA lending has never been very large and is not likely to be a factor in future farm credit conditions (Hughes, et al. 1986). Finally, state programs are so diverse that they would constitute the basis for another research project.

The historic period 1978 through 1985 was chosen for this study. FmHA's Economic Emergency Loan Program was initiated in 1978 and, in large part, led to a fourfold increase in FmHA loans to farmers from the end of 1977 to 1985 (USDA). The period also covers times of rapid growth in farm debt and times of financial difficulties with associated declines in farm debt. It continues through the end of 1985, which was the latest time period for which all data were available.

Description of Subsidies and the Overall Approach

Subsidies are government actions that change the distribution of resources in the economy in an attempt to reach policy goals. Farm financial subsidies redirect credit from the rest of the economy toward farmers. There are always two aspects to a subsidy: (a) the method of distribution to and the size of benefits received by the target group and (b) the method of allocation and the size of the cost of the benefits. Thus, in order to understand all of the influences of farm credit subsidies, it is important to measure both aspects: (a) the benefits received by farmers and (b) the ways the benefits are funded to pass the costs of the subsidies to the rest of the economy.

Benefits are provided to farm borrowers in the real estate and nonreal estate debt

markets. Given the different uses of those two types of loans, it would seem evident that separate measures of credit subsidies in those two categories could provide the foundation for answering substantially different questions. Therefore, the subsidies are separated into those two categories to estimate the reductions in interest rates on farm real estate and nonreal estate loans.

In this research, the approach taken to measuring the benefits of farm credit subsidies differs markedly from that employed in other studies (Office of the U.S. Comptroller General; Weidenbaum; Lieblich). Most previous work compares FmHA and FCS interest rates with commercial bank rates and uses the difference as a measure of the subsidy.¹ As pointed out by Hughes, et al. (1984), however, such a practice understates the subsidy from the FmHA and may overstate the subsidy from the FCS. The understatement of the subsidy from the FmHA is related to the risks of lending to farmers who "cannot get credit elsewhere." Comparing FmHA rates with the rates of interest charged farmers who satisfy the credit worthiness standards of commercial banks does not account for the potential loan losses associated with funding a more risky set of farmers and, therefore, understates the subsidy provided by FmHA. To some extent, this type of argument also applies to the FCS. Having the lower cost of funds associated with agency status may have allowed the FCS to make loans to some marginal farmers who would not otherwise have received credit. Moreover, agency status may have lead to FCS loan decisions that did not properly incorporate the full implications of the risk of the loan. On the other hand, comparing FCS loan rates with commercial bank rates leads to an overstatement of the government subsidy in periods of rising interest rates. In the past, FCS has priced loans based on its average cost of funds. As interest rates rose, that averaging process slowed the increases in new loan rates by spreading the cost among all borrowers. Thus, much of the difference between FCS and commercial bank interest rates on farm loans in the 1970s can be explained as a

¹One other approach that has been used is to measure FmHA subsidies on the basis of actual government expenditures on the program assuming all loans are repaid. Such an approach greatly understates the size of the subsidy.

subsidization of new borrowers by established borrowers, which did not involve government funds.

To avoid those problems in this study, lenders' interest charges are divided into three components: a cost of funds, an operating margin, and a risk premium, each of which may or may not be subsidized. By identifying the impacts of government actions on each of those components, the total impact of government involvement can be calculated regardless of the borrowers' risk classifications and the internal pricing policies of the lending organizations. The major portion of most interest rates charged by lenders reflects the lender's cost of funds. A subsidy arises when the actual cost of funds to the lender is not covered in the cost of the loan (for example in FmHA's emergency loans made at Congressionally mandated interest rates). Operating expenses can also be subsidized. Borrowers are not charged additional interest to cover the costs of running the FmHA, and tax laws provide some exemptions for the FCS. Finally, risk premiums, which reflect anticipated loan losses, should be included in determining credit subsidies. Losses may develop, which if paid by the government, provide subsidies to borrowers. Total subsidies to borrowers are then the sum of subsidies from each of the three components.

Measuring the means of funding farm credit subsidies requires identifying the differences that would have existed in tax receipts, the money supply, and government bonds, if the subsidies had not been pursued. In this study, the vast majority of funding for farm credit subsidies is assumed to come from the creation of government or quasi-government bonds. The FmHA is funded by the U.S. Treasury, and its direct loans clearly increase government debt. FmHA loan guarantees and perceptions associated with agency status for the FCS transfer the risk classification of the U.S. government to FmHA guaranteed loans and FCS bonds. In this study, such financial instruments are considered quasi-government bonds, and are assumed to be close, if not perfect, substitutes for actual government bonds, both in terms of their ability to fund government actions and in their effects on credit markets.

Benefits from the FmHA

FmHA is the principal direct government lender to farmers. As such, it subsidizes farm loans in several ways. Some loans are made at Congressionally mandated interest rates that do not reflect conditions in financial markets. The U.S. government also pays for operating FmHA, so interest rates on its loans do not fully reflect an operating margin. Because FmHA is only supposed to lend to rural residents who cannot obtain credit elsewhere and does not accumulate loan loss reserves, it provides loans to risky borrowers at significantly subsidized rates of interest.² Finally, in addition to making direct loans to farmers, FmHA also guarantees loans made by other lenders. Such guarantees add to the risk exposure of the government and provide an additional source of farm credit subsidies.

Costs of Funds Subsidies

Many of the FmHA loan programs had artificially low interest rates prior to 1979 when most of the loan programs switched to charging interest rates reflecting the government's cost of funds. Even today, however, the interest rates of Emergency Disaster Loans from FmHA are from 1 to 5 percent. Thus, there are still significant farm credit direct subsidies provided by FmHA's real estate and nonreal estate lending programs; see columns A and E in Table 1. The numbers in column A are developed by measuring the difference between the FmHA subsidized rate and the annual average interest rate on a constant maturity twenty-year government bond (*Federal Reserve Bulletin*) and then multiplying the difference times the amount of subsidized debt to

²One problem faced in measuring FmHA subsidies is how to handle the difficulties posed by loan guarantees. To some extent loan guarantees are included in the measures presented in this study. There is no cost of funds subsidy in guarantees because they do not represent an actual loan. The cost of operating the guarantee program is included in the measures of the subsidies. And, any recognized losses from the guarantee program are included in the risk premium subsidy. However, data is not available to even suggest an order of magnitude for a hypothetical loan loss reserve for the guaranteed loans. Therefore, to the extent that the government will have to make payments on guaranteed loans, the FmHA subsidies reported above are understated.

Table 1. Farm Credit Subsidies Through the Farmers Home Administration: 1978-85

Years	Real Estate Debt				Nonreal Estate Debt ^a				Total Subsidy (I)	Subsidy Rate (J) ^b
	Cost of Funds	Operating Margin	Risk Premium	Total	Cost of Funds	Operating Margin	Risk Premium	Total		
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)		
Millions of Dollars										
1978	209.0	3.3	2.0	214.3	121.0	184.8	309.2	615.0	829.3	8.3%
1979	262.5	26.2	25.5	314.2	265.9	183.3	480.6	929.8	1,244.0	7.7%
1980	355.1	27.6	31.0	413.7	398.8	207.8	629.0	1,235.6	1,649.3	8.5%
1981	431.9	29.7	39.7	501.3	834.2	214.0	773.2	1,821.4	2,322.7	10.0%
1982	374.0	36.1	43.2	453.3	660.0	244.0	789.6	1,693.6	2,146.9	9.0%
1983	341.9	42.0	48.6	432.5	408.4	250.9	784.0	1,443.3	1,875.8	7.7%
1984	402.5	47.6	53.4	503.5	512.1	276.5	837.8	1,626.4	2,129.9	8.3%
1985	338.0	51.3	57.1	446.4	303.8	298.1	897.2	1,499.1	1,945.5	7.1%

^aNonreal estate debt includes FmHA operating, soil and water, Emergency Disaster and Economic Loan Programs.

^bTotal subsidies divided by total FmHA farm loans.

develop a dollar value.³ Numbers in column E are developed by taking the difference between the subsidized rate and the annual average interest rate on one-year Treasury Bills (*Federal Reserve Bulletin*) and then multiplying times the amount of outstanding subsidized nonreal estate farm debt. Due to a lack of available data and the desire to be conservative in measuring the subsidies from FmHA, the maximum 5 percent rate was chosen as the FmHA rate on specially subsidized interest rate loans for all years. Those special loans, principally Emergency Disaster Loans since 1979, account for the cost of funds subsidies in the nonreal estate debt markets in Table 1. While interest rates on FmHA real estate loans changed to cover the cost of government borrowing in 1979, many fixed rate loans made before 1979 were still outstanding during the study period. Those loans were amortized assuming a thirty-year maturity and a constant payment every year to reduce the amount of the old loans over time.

Operating Margin Subsidies

The costs of operating FmHA also generate

³Throughout the study economic actors are assumed to try to match the maturity of their assets and liabilities. If, for example, short-term government bond rates are used to measure the cost of fund subsidies on FmHA real estate loans there would be the assumption of a clear mismatch between government assets and liabilities. When private lenders pursue such policies they eventually run into difficulties as evidenced by some of the problems faced by the FCS and the condition of the savings and loan industry in the early 1980s. Thus, any reduction in the cost of funds subsidy for FmHA real estate lending generated by assuming a shorter maturity on bonds used to finance the debt would have to be offset by a higher risk premium.

subsidies in the farm credit markets because, if FmHA loans were to be provided by private sector lenders, the loans would have to cover such costs. To measure the second component of FmHA credit subsidies, we allocate the value of FmHA administrative costs on the basis of the relative costs of administering real estate and nonreal estate loans in the FCS. Operating expenses per dollar of loans outstanding are calculated for both Production Credit Associations (PCAs) and the Federal Land Banks (FLBs) from 1978 to 1985. Over the period, PCA loans are found to require three times as many operating dollars as loans from the FLBs. FmHA administrative expenses are then divided between real estate and nonreal estate loans to reflect both the composition of FmHA's loan portfolio and the relative costs of administering the different types of loans. This process captures government payments for operating FmHA's direct and guarantee farm loan programs. The costs run in the hundreds of millions of dollars each year (see Table 1) and should not be ignored in calculating subsidies.

Risk Premium Subsidies

Finally, a large part of the subsidies provided by FmHA come through ignoring risk premiums on its loans. Measuring the unobserved subsidies is not easy, and there can be no claims of accuracy in any process employed. The method used to develop measures of required risk premiums for FmHA begins with estimating the size of the loan losses that would have been recognized by private lenders and then calculates the yearly additions to interest charges needed to

establish a loan loss reserve sufficient to cover such losses.

FmHA loan delinquency data were used to identify net loan losses that might have been taken on FmHA's direct loans to farmers, if FmHA operated under regulations similar to those faced by other lenders to agriculture.⁴ Table 2 shows the dollar amounts of FmHA delinquent loans by age of delinquency as of December 31, 1985. Also shown are the fractions of each delinquency category assumed to be lost if FmHA was able and desired to deal with loans in the same way as private lenders. Conversations with private lenders suggest that, if anything, the assumed fractions understate the losses that FmHA would have to recognize if the loans were to be privatized. Actual FmHA loan write-offs are also included by compounding them forward to the end of 1985 using the Treasury Bill interest rate. Indices of the value of FmHA loans outstanding are then used to develop an unequal stream of contributions to a hypothetical loan loss reserve sufficiently large to cover FmHA loan losses.⁵ FmHA interest income would have to have been several hundred million dollars higher each year of the study to generate a loan loss reserve of more than \$8 billion by the end of 1985.⁶

⁴Data on the condition of FmHA guaranteed loans were not available to the authors.

⁵There have been cases where private agricultural lenders have exceeded their loan loss reserves so that the calculation of a loan loss reserve that completely covers FmHA's hypothetical losses overstates the risk premium subsidy to some degree. Offsetting that, however, is the very conservative approach taken in identifying FmHA's potential losses.

⁶Not all loan losses for FmHA at the end of 1985 would be due to loans made since 1978. Corrections to overcome that problem in the real estate debt markets were made. Nonreal estate loans are assumed to have maturities of seven years or less so no adjustments were made. Real estate loans do have longer maturities and are amortized assuming thirty-year maturities to reflect the payoffs of old loans in developing new real estate loans made each year. Therefore, the 1978 through 1985 period is only charged a risk premium sufficient to cover losses on loans made during those years.

Adjustments were made to the contributions to the loan loss reserve (LLR) to account for compound interest and varying levels of loans outstanding. Basically the LLR at the end of 1985 should have been equal to a set of contributions compounded forward, or $LLR = C_{85} + C_{84}(1+r_{85}) + C_{83}(1+r_{84})(1+r_{85}) + \dots$ where C_{xx} is the contribution to the LLR in the year xx

**Table 2. Farmers Home Administration
Loan Delinquencies as of
December 31, 1985**

Age	Dollar Amount*	Assumed Loss Rate	Assumed Losses
	Millions		Millions
< 1 Year	\$1,944	25%	\$ 486
1-2 Years	1,127	50	563
2-3 Years	1,024	75	768
> 3 Years	6,285	100	6,285
TOTAL ASSUMED LOSSES			\$8,102

*From FmHA Finance Office, Form FMHA 389-375-B.

Total FmHA subsidies in farm credit markets are shown in the last column of Table 1. The amounts of subsidy are significant. Holding everything else constant, nonsubsidized loans from FmHA would have cost, on average, \$1.8 billion more each year and would have had an interest rate more than eight percentage points higher than what was actually charged. Moreover, those subsidies are probably understated to the extent that FmHA guaranteed loans are likely to generate the need for even more government funds as losses are recognized.

Benefits from the FCS

The principal government-granted advantage enjoyed by FCS is agency status, which leads to farmers paying lower interest rates on loans than they would in its absence (Lins and Barry). As a government agency, the FCS can sell its bonds in national financial markets at lower interest rates than would otherwise be the case. The savings are then passed on to farm borrowers. Agency status for the FCS makes the interest on its bonds

and r_{xx} represents the interest rate for year xx . Define an interest factor, the multiplication of all the $(1+r)$'s, to be IF_{xx} for the year xx . Contributions are assumed to be proportional to loans outstanding in each year so an index is constructed such that $ID_{xx} = LO_{xx} / \text{avg}(LO)$ where ID_{xx} is the index factor for the year xx , LO is loans outstanding, and $\text{avg}(LO)$ is the average of loans outstanding for the period. The contribution for any given year is then a constant (C) times the index factor for the year and

$$LLR = C \sum_{i=0}^n (ID_{t-i} IF_{t-i}), \text{ which implies that } C = \frac{LLR}{\sum_{i=0}^n (ID_{t-i} IF_{t-i})}.$$

Once C is known, each year's contribution can be calculated by multiplying by ID_{xx} .

Table 3. Farm Credit Subsidies Through Agency Status for the Farm Credit System

Years	Real Estate Debt				Nonreal Estate Debt				Total Subsidy (I)	Subsidy Rate ^a (J)
	Cost of Funds (A)	Operating Margin (B)	Risk Premium (C)	Total (D)	Cost of Funds (E)	Operating Margin (F)	Risk Premium (G)	Total (H)		
	<i>Millions of Dollars</i>									
1978	1.9	76.5	2.1	80.5	1.1	38.0	4.2	43.3	123.8	.3%
1979	2.2	103.0	5.1	110.3	1.4	47.1	5.1	53.6	163.9	.4%
1980	2.7	149.7	8.8	161.2	1.5	83.7	5.6	90.8	252.0	.5%
1981	3.3	183.1	13.2	199.6	1.6	90.2	6.0	97.8	297.4	.5%
1982	3.5	239.2	15.6	258.3	1.5	86.9	5.8	94.2	352.5	.5%
1983	3.7	122.0	16.6	142.3	1.5	52.8	5.5	59.8	202.1	.3%
1984	3.7	83.8	17.2	104.7	1.3	44.0	5.1	50.4	155.1	.2%
1985	3.4	0 ^b	15.1	18.5	1.1	0 ^b	4.0	5.1	23.6	0%

^aTotal subsidy divided by total FCS farm loans.

^bAggregate net income less than zero suggests a zero tax liability.

exempt from state and municipal taxes and leads to several other characteristics that make FCS bonds more attractive to investors. Those special characteristics become government benefits to farmers as the FCS charges less to cover its cost of funds than it would without agency status. Parts of the FCS are not taxed and, therefore, face lower operating costs than corporate lenders. Agency status also allows for a lower risk premium in FCS lending rates. Agency status implies the implicit (or explicit) government backing of FCS bonds. Thus, if loan loss reserves for the FCS are not sufficient to cover loan losses, the government has a perceived contingent liability to cover such losses that, if triggered, would imply a subsidy to farmers.

Cost of Funds Subsidies

Lins and Barry summarize previous work related to the impacts of FCS agency status on interest rates charged by the system. The work that they report on the state and local tax advantages of FCS bonds is used in this study to reflect the government-generated advantages of agency status on the FCS's cost of funds. The advantages of tax exclusion depend on the marginal tax rates of the purchasers of FCS bonds and such an effect is impossible to quantify with precision.⁷ However, the midpoint of the

range of values reported by Lins and Barry—7.5 basis points—was used as an estimate of the increase in FCS rates that would occur if interest on FCS bonds were to be taxed by state and local governments. Multiplying 7.5 basis points times the amount of real estate and nonreal estate debt outstanding by the FCS yields columns A and E in Table 3.

Some confusion may arise because only the exclusion of state and local taxes on FCS bonds is used to identify the government's influence on the cost of funds to FCS. Certainly agency status also generates a lower cost of funds due to the perceived government backing of its bonds. However, if the FCS constantly holds a loan loss reserve sufficient to cover any loan losses, then a risk-free cost of funds would be justified regardless of agency status. Thus, only if the government is actually required to supplement the FCS's reserves does agency status represent a change in the risk classification of the system, and the effects of agency status on borrowing costs are included below in measuring the FCS's risk premium subsidy.

Operating Margin Subsidies

Several of the component banking systems of the FCS do not pay taxes, including the Federal Land Banks (FLB), the Federal Land Bank Associations (FLBA) and the Federal Intermediate Credit Banks (FICB), (Barry et al.). That probably leads to lower operating margins on FCS loans than would be included in lending rates from corporate lenders. Lins and Barry used the average tax rate of the PCAs applied to the net earnings

⁷Lins and Barry describe a budgeting approach showing the advantages of the state and local tax exemption of the FCS's bonds to a "typical" investor to be about 74 basis points. They surveyed bond dealers who suggested the actual advantage is between 5 and 10 basis points. Because the budget is hypothetical, the midpoint of the survey range, 7.5 basis points, is assumed in this study.

of the tax exempt banks to estimate the tax benefits for farmers in 1979 and 1980. A similar approach is used in this study to develop columns B and F in Table 3. The average PCA tax rate for the years 1978 through 1981, 38 percent, is multiplied times the reported net earnings of the FICBs to get the tax benefit for nonreal estate loans and the combined net earnings of the FLBs and the FLBAs to get the tax benefit for real estate loans (Farm Credit Administration).⁸ The procedure overstates tax benefits in that the managers of the FCS would likely have pursued tax avoidance measures if their organizations' income had been taxed during the period. Offsetting that to some extent is an aggregation bias. Each local and district bank is a separate taxable entity. Thus, losses for some banks could not be used to offset earnings elsewhere in the system. A negative aggregate income, therefore, would not necessarily imply a zero tax obligation for all of the banks. As an example, PCAs paid more than \$25 million in taxes in 1983, even though aggregate PCA net earnings before taxes show a \$30 million loss.

Risk Premium Subsidies

Lins and Barry do not describe any accounting for the value of the government's contingent liability in case loan losses exceed the FCS's capital. Like FmHA, the government's liability can be measured as a stock value at the end of 1985, and hypothetical increases in interest rates required to cover such losses can be calculated for the 1978 to 1985 period. Unlike FmHA, however, government money that may be provided to the FCS is expected to be in the form of a loan rather than a grant. Thus, much of the value of the government's aid will become an intertemporal transfer from future borrowers to past borrowers, rather than a transfer from taxpayers. If such is the case, then the stock value of the subsidy would be the difference in the net present value of the loan discounted at the Treasury cost of funds versus the cost of funds for the FCS.

To develop the value of the FCS risk premium subsidy, the Farm Credit Administration's estimate of \$5.5 billion in funds required by the FCS is assumed to have been made available at the end of 1985 as a loan (Farm Sector Economics Associates). The government loan is assumed to have a twenty-year maturity and Treasury and FCS borrowing rates are assumed to be at the 1986 average rates for five-year bonds issued by both organizations, 7.29 percent and 7.92 percent, respectively. As a result, the subsidy generated by government help for the FCS would have amounted to \$268 million on December 31, 1985, and the additional contributions to capital required to build a reserve of that amount are shown in Table 3. Total dollar values of the subsidies and the reduction in overall FCS interest rates generated by FCS agency status are also reported at the end of the table.

Total Credit Subsidies to Farmers

Total credit subsidies provided by both FmHA and the FCS are reported in Table 4 for the years 1978 through 1985. The hypothetical interest expense reductions are then divided by total farm debt outstanding to generate approximations of the reductions in farm real estate and nonreal estate interest rates due to the existence of FmHA and the agency status of the FCS.

Real estate subsidies from FmHA and the FCS are of the same order of magnitude, though in every case the subsidies from the FCS are lower than those provided by FmHA. FmHA's real estate loan portfolio is much smaller than that of the FCS, but the subsidies provided on each dollar of FmHA debt are much greater. In many years, the total subsidy in the farm real estate credit markets has been over a half-billion dollars. That translates into a reduction in interest rates of 40 to 70 basis points that farmers paid on real estate debt.

Subsidies in nonreal estate farm credit markets are much greater than those generated in the real estate debt market. And, the nonreal estate debt subsidies provided by FmHA are substantially greater than those provided by the FCS. The volume of FmHA's

⁸The years 1982 through 1985 are excluded in the process of averaging the PCA's tax rate because of a significant shift in the aggregate tax rate starting in 1982. In fact, the tax rate is infinite in the years 1983 through 1985, when losses in some associations were greater than the earnings of all others.

Table 4. Total Credit Subsidies Provided to Farmers Through the Farmers Home Administration and Agency Status of the Farm Credit System: 1978-85

Year	Real Estate Debt					Nonreal Estate Debt				
	Farmers Home Administration	Farm Credit System	Total Subsidy	Debt Outstanding ^a	Interest Rate Subsidy	Farmers Home Administration	Farm Credit System	Total Subsidy	Debt Outstanding ^a	Interest Rate Subsidy
	<i>Millions of Dollars</i>					<i>Millions of Dollars</i>				
1978	214.3	80.5	294.8	67,534.0	.4%	615.0	43.3	658.3	64,510.0	1.0%
1979	314.2	110.3	424.5	78,604.5	.5%	929.8	53.6	983.4	74,984.0	1.3%
1980	413.7	161.2	574.9	90,681.5	.6%	1,235.6	90.8	1,326.4	83,518.0	1.6%
1981	501.3	199.6	700.9	100,782.5	.7%	1,821.4	97.8	1,919.2	91,434.0	2.1%
1982	453.3	258.3	711.6	107,889.5	.7%	1,693.6	94.2	1,787.8	101,750.0	1.8%
1983	432.5	142.3	574.8	111,409.0	.5%	1,443.3	59.8	1,503.1	105,392.0	1.4%
1984	503.5	104.7	608.2	112,420.0	.5%	1,626.4	50.4	1,676.8	102,184.5	1.6%
1985	446.4	18.5	464.9	108,811.0	.4%	1,499.1	5.1	1,504.2	99,977.0	1.5%

^aDebt Outstanding is in both cases total debt outstanding for the sector. Thus, the subsidy rate is an average for all farm real estate or nonreal estate.

nonreal estate loans is much greater than the volume of its real estate loans, so a vast majority of FmHA subsidies are concentrated in that market. The FCS loan portfolio is more heavily concentrated in real estate loans so fewer advantages of agency status for the FCS flow to the nonreal estate credit markets. In addition, PCAs, the local organizations of the FCS that provide nonreal estate loans, are taxed, which also reduces the FCS's subsidies in the nonreal estate credit markets. Total subsidies in the nonreal estate debt markets, therefore, strongly reflect growth in FmHA lending in the late 1970s and early 1980s and the declines in market interest rates since then. Starting at about two-thirds of a billion dollars in 1978, the subsidies grew to almost two billion dollars in 1981. By 1985, the subsidies declined to slightly more than one and one-half billion dollars. Translating the subsidy values to reductions in interest rates suggests that, on average, farmers paid between 100 and 210 basis points less for nonreal estate debt during the period than they would have had to pay without FmHA and FCS agency status.

Funding Federal Farm Credit Subsidies

Measuring the government actions required to finance federal farm credit subsidies is as important as measuring the benefits to farmers in understanding the overall effects of a subsidy. Given that the federal government ran deficits in excess of the size of farm credit subsidies in each year of the

study period, it is assumed that the majority of the subsidies were bond financed. Assuming bond financing of credit subsidies is also consistent with the concept of the government matching the maturity of its programs with their financing. The benefits of subsidizing farm debt may be reasonably anticipated to generate benefits over the maturity of the debt, and assuming that the government defers payment on those costs for a similar amount of time would seem rational. Only the portion of the subsidies directly related to the tax exempt status of the FCS's bonds and the tax exempt status of portions of the system are assumed to be financed by taxes. The effect on government tax receipts is the reverse of the tax benefits provided to farmers, as shown in columns A, B, E, and F of Table 3.

Table 5 presents the decreases in government and quasi-government bonds that would have occurred if FmHA had stopped making loans and the FCS had lost agency status at the beginning of 1978. The numbers are simply the total amount of new credit provided by FmHA and the FCS during the study period. Adjustments to loans outstanding were needed to avoid accounting for pre-1978 subsidies within the period. All nonreal estate loans are included in total because of their short maturity. However, real estate loans from year-end 1977 are amortized using an assumed thirty-year maturity to identify new loans made during the period. New loans made each year, therefore, are equal to the change in loans

Table 5. Government and Quasi-Government Debt Associated with Subsidized Credit for Farmers: 1978-85.

Years	Real Estate Debt Since 1977				Nonreal Estate Debt Since 1977				
	Farmers Home Administration	Farm Credit System	Total ^a	Inflation Adjusted ^b	Farmers Home Administration	Farm Credit System	Total ^a	Inflation Adjusted ^b	Total Charge in Borrowing ^a
<i>Billions of Dollars</i>									
1978	.3	4.0	4.3	2.1	2.6	1.4	4.0	2.0	8.3
1979	3.4	9.7	13.1	6.0	5.8	4.6	10.4	4.8	23.5
1980	4.1	16.8	20.9	8.8	8.6	6.2	14.8	6.2	35.7
1981	5.3	25.1	30.4	11.6	11.3	7.7	19.0	7.3	49.4
1982	5.8	29.7	35.5	12.7	11.6	7.0	18.6	6.7	54.1
1983	6.5	31.5	38.0	13.1	11.5	5.8	17.3	6.0	55.3
1984	7.1	32.7	39.8	13.2	12.5	4.4	16.9	5.6	56.7
1985	7.6	28.7	36.3	11.7	13.6	.5	14.1	4.6	50.4

^aMay not add due to rounding.^bAdjusted for inflation by dividing by the GNP deflator with 1967 equal to 1.

outstanding plus the assumed repayment of long-term loans made before 1978. The numbers reported in the table for FmHA's and the FCS's real estate loans outstanding are the accumulation of the new loans made since the beginning of 1978. The final columns under real estate and nonreal estate loans in Table 5 represent the inflation-adjusted reductions in government and quasi-government bonds that would be consistent with removing government credit subsidies to farmers.

The maximum change in government debt reported in Table 5, fifty billion dollars, is about one-quarter of all farm debt, but does not represent a major portion of the federal government's debt or the national debt. At the end of 1985 federal government debt was more than \$1.8 trillion (Council of Economic Advisors). Thus, government and quasi-government debt associated with farm credit programs was only 3 percent of the total. Nationally, households owed \$2.5 trillion, and nonfarm corporate businesses owed \$2.2 trillion at the end of 1985 (Board of Governors of the Federal Reserve Bank). Thus, the portion of total national debt diverted to the farm sector through government programs was less than eight-tenths of 1 percent.

Conclusions

Federal farm credit subsidies provided through FmHA and the FCS have been significant over the last eight years. Total

subsidies run in the billions of dollars each year. They have reduced interest rates faced by farmers from one-half to two percentage points, particularly in the nonreal estate credit markets. Such subsidies have probably led to higher debt loads for farmers, higher land values, a greater capital stock, and more farm production that would have been the case in their absence. The costs of generating such subsidies have, however, been rather small relative to U.S. financial markets. They have involved diverting less than fifty billion dollars of credit, or about eight-tenths of 1 percent of total U.S. debt, away from other sectors and to farmers.

References

- Barry, P.J., J.A. Hopkin, and C.B. Baker. *Financial Management in Agriculture*. Danville, IL: Interstate Printers and Publishers, 1983.
- Board of Governors of the Federal Reserve System. *Federal Reserve Bulletin*. March 1986.
- Board of Governors of the Federal Reserve System, Division of Research and Statistics. *Balance Sheets for the U.S. Economy: 1946-85*. October 1986.
- Comptroller General of the U.S. *Long-Term Cost Implications of Farmers Home Administration Subsidized and Guaranteed Loan Program*. PAD-7915. Washington, D.C.: U.S. General Accounting Office, 1979.

Council of Economic Advisors. *Economic Report of the President*. Washington, D.C.: U.S. Government Printing Office, 1986.

Farm Credit Administration. *Annual Report of the Farm Credit Administration*. Washington, D.C.: Farm Credit Administration, 1977-78 through 1984-85 reports.

Farm Sector Economics Associates. *Farm Financial Conditions Review*. Edited by S. Gabriel and P. Prentice. November 1985.

Hughes, D.W., C.R. Bednarz, N.K. Osborn, and D.B. Hall. *Social Costs and Benefits of Subsidized Credit for the Farm Sector*. Thornton Agricultural Finance Institute RWP 87.1. Texas Tech University publication no. T-1-246, January 1987.

Hughes, D.W., S.C. Gabriel, P.J. Barry, and M.D. Boehlje. *Financing the Agricultural Sector: Future Challenges and Policy Alternatives*. Boulder: Westview Press, 1986.

Hughes, D.W., J.B. Penson, Jr., and C.R. Bednarz. "Subsidized Credit and Investment in Agriculture: The Special Case of Farm Real Estate." *Amer. J. of Agr. Econ.* 66(1984):755-60.

Liebllich, M.S., "Issues in the Identification and Measurement of Credit Subsidies." In proceedings of *Evaluating Financial Markets for Agriculture* seminar sponsored by North Central Regional Project NC-161, St. Louis, Missouri, October 1984.

Lins, D.A., and P.J. Barry. "Agency Status for the Cooperative Farm Credit Systems." *Amer. J. of Agr. Econ.* 66(1984):601-606.

Melichar, E. *Agricultural Finance Databook*. Division of Research and Statistics, Board of Governors of the Federal Reserve System. Selected quarterly issues.

U.S. Department of Agriculture, Economic Research Service. *Agricultural Finance Outlook and Situation Report*. AFO-26. March 1986.

Weidenbaum, M.L. "Subsidies in Federal Credit Programs." In *The Economics of Federal Subsidy Programs: A Compendium of Papers* prepared by the Joint Economic Committee. Washington, D.C.: U.S. Government Printing Office, 1972.

Refinancing Agricultural Loans

Lindon J. Robison, David A. Lins, and, Steven R. Koenig

Abstract

Borrowers are aware that interest rates have fallen and that they may increase in the future. This situation offers borrowers the opportunity to lower financing costs by refinancing existing loans. In most cases, however, refinancing to obtain lower interest rates comes with significant closing fee costs. This paper explores break-even conditions and net present values associated with refinancing decisions under a variety of loan closing conditions for fixed payment loans.

Key words: closing costs, refinanced loans, market interest rates, new loan interest rate, old loan interest rate, taxes.

Agricultural firms borrow money to finance purchases of operating and capital inputs. Lenders provide funds to make those purchases under a variety of loan terms and conditions. As economic conditions change, the advantages of one type of loan over another type of loan are altered, and farm borrowers are faced with the question: "Should I refinance my loan?"

Unfortunately, the procedures used to evaluate refinancing alternatives are often ad hoc and inappropriate. For example, one rule of thumb for evaluating refinancing decisions suggests that loans should be refinanced if the new interest rate is 2 percent lower than the old rate and if savings from the monthly mortgage payment pay for loan closing costs in three years (Bruss).

The purpose of this paper is to explain how various factors affect refinancing decisions. The purpose is achieved by deriving equations that determine the benefits and costs of refinancing loans. The focus of this paper is not on the equations that we derive, but rather on the questions the equations can answer. So the body of the paper asks and answers a variety of refinance questions using one of two general equations derived in the appendix.

Several factors are important when considering the refinancing of a loan. They include the current interest rate, the interest rate on the old loan, the interest rate on the refinanced loan, future interest rates, and refinancing costs. The benefits and costs of refinancing a loan also depend on tax rates, on whether interest costs shield income, and on what portion of closing costs is tax deductible. Finally, the decision depends on when closing costs are paid and how loan maturities are altered when a loan is refinanced.

Refinancing alternatives should be considered on an after-tax basis because some of the benefits of refinancing to

Lindon J. Robison is a professor in the Department of Agricultural Economics at Michigan State University. David A. Lins is a professor in the Department of Agricultural Economics at the University of Illinois. Steven R. Koenig is an agricultural economist with the Economic Research Service, U.S. Department of Agriculture. The authors thank Timothy G. Baker and John R. Brake for helpful review comments on an earlier draft of this paper. Michigan Agricultural Experiment Station journal article no. 12344.

achieve lower interest rates are offset by a reduction in the tax shield provided by the higher interest costs. In addition, loan origination fees and points are generally tax deductible either in the year of closing or as they are repaid over the life of the loan. Other refinancing expenses such as attorney fees, recording fees, title insurance, and transfer taxes are not tax deductible; however, they can be added to the basis of the property. All of these considerations require an appropriate analysis to be made on an after-tax basis.

Basis of Comparison

To evaluate refinancing alternatives, we establish a basis of comparison between the old loan and the new loan. Many bases for comparison could be envisioned including both economic and noneconomic criteria. In this article, we focus on two economic criteria—break-even loan closing fees and net present values of cash flows.

The break-even loan closing fees approach calculates the maximum loan closing fees that could be paid to close the new loan and leave the borrower indifferent between the old loan and the new loan. If the actual closing fees charged are less than the break-even fees, then the borrower would likely opt for refinancing. The break-even approach, however, does not indicate *how much* better off or worse off the borrower would be by refinancing.

The net present value approach compares cash flows under the old loan with cash flows under the new loan. The one with the lowest present value of cash flows is the preferred alternative. That approach also indicates how much better off or worse off the borrower is with refinancing.

In what follows, several refinance questions are asked and answered. The questions are answered either by calculating the break-even loan closing fee or by calculating the net present value of refinancing the loan. The formula that calculates the break-even fee under a variety of loan closing conditions is equation G.1. Net present value answers are calculated using equation G.2. Both equations are derived in the appendix.

Net Present Value and Break-Even Closing Fees of Refinancing Loans

Trade-off between closing fees and lower interest rates. The most common refinancing questions involve the trade-off between closing costs versus the benefits of a new loan at a lower interest rate. Consider the following examples.

Suppose firm A owes \$100,000 on a loan that matures in twenty years. Loan terms include semiannual payments at an annual percentage rate (APR) of 12 percent. Assume the firm's opportunity cost of capital is 8 percent, and it faces a marginal tax rate of 28 percent.

Now assume that firm A has the opportunity to refinance the loan. The new loan terms are the same except that the APR is 11 percent. Closing fees are 80 percent tax deductible and will be included in the loan. What is the maximum loan closing fee that the firm can pay and still break even with the existing loan terms? Using equation G.1, the maximum break-even loan closing fee is 6.29 percent. If the loan fee is less than 6.29 percent, firm A is better off to refinance based on economic factors.

By using equation G.2, the net present value of the new loan versus the old loan is reported as \$6,818. If the new loan requires a 2 percent loan closing fee, the net present value declines to \$4,648. By knowing the net after-tax present value of the new loan, the borrower can better decide whether noneconomic factors, such as lender loyalty, offset the savings of the new loan.

Next consider the same old and new loans available to firm A; loan maturities are now five years instead of twenty years. In addition, a 3 percent loan closing fee is required by the new lender. By applying equation G.1, the break-even loan closing fee is 2.25 percent—less than the 3 percent fee required by the new lender. The net present value of the refinancing is -\$650. Obviously, when offered those loan terms, firm A is better off not to refinance the existing loan.

Refinancing constant payment loans with different maturities. By allowing the new loan maturity m_n to differ from the old loan maturity m_o , the analysis becomes more

complex. To illustrate how equation G.1 can be used to analyze loans with different maturity lengths, we consider firm B, which has two refinancing options for a \$100,000 loan.

The current loan has a maturity of fifteen years, semiannual payments, and an APR of 11 percent. Assume that firm B has a marginal tax rate of 15 percent, its opportunity cost of capital is 8 percent, and all of its loan closing fees are tax deductible. The first option provides the same loan terms except the maturity is now ten years instead of fifteen years, the APR is 10.5 percent, and a 2 percent loan closing fee is required. Under that option, equation G.1 yields a break-even loan closing fee of 7.03 percent.

Under the second option, the loan maturity remains at fifteen years, but the interest rate is now 10 percent APR. Payments are to be made annually. Under those terms, the break-even loan closing fee decreases to 5.62 percent. The first option seems preferable because it has the higher break-even fee, but because it requires a 2 percent closing fee, the second option is preferred. That decision is based on a higher net present value of the second option. Using equation G.2, we find that the net present value of the first and second options are \$5,021 and \$5,788, respectively.

Refinancing loans and uncertain maturities. Frequently loans are refinanced but not held to their full maturity. If the borrower anticipates that early repayment of the loan may occur, refinancing decisions need to be adjusted. Early repayment of the loan could occur before interest rate savings have repaid loan closing fees, making refinancing undesirable. Equations G.1 and G.2 can be used to provide answers for refinancing when loans may not be held to full maturity.

To illustrate those types of refinancing situations, we consider the same loan options used by firm B in the previous example. Now suppose that firm B selects the second option and anticipates that early loan repayment may occur in five years. What is the maximum loan closing fee that the firm can pay and still break even with the current loan? By using equation G.1, we find the maximum loan closing fee declines to

3.54 percent. Conversely, under the first option, the break-even fee is 2.42 percent. Clearly, the second option is preferred.

More Complicated Refinance Problems

Questions more complicated than our previous examples can be answered by using equations G.1 and G.2. To illustrate the application of G.1 and G.2 to a more complicated case, we consider the following refinancing problem.

Due to a decline in interest rates, firm C is considering the refinancing of a twenty-year loan with seventeen years left to maturity. The outstanding loan balance is \$100,000, and a balance of \$2,000 remains on the old loan closing fees. Loan closing fees are 80 percent tax deductible. Loan terms include an 11 percent APR on the old loan and semiannual payments. Firm C is in the 28 percent marginal income tax bracket and considers its opportunity cost of capital to be 8 percent.

The new loan option carries an APR of 9.7 percent with annual payments for twenty years and a closing fee of 3 percent, which is 100 percent tax deductible. Using equation G.1, the break-even loan closing fee is calculated to be 6.07 percent—greater than the 3 percent required to close the new loan. Therefore, refinancing the loan will lower the firm's financing cost. The net present value resulting from the refinancing option—calculated using G.2—is \$3,101.

If the firm is in the 15 percent marginal tax bracket, the break-even loan closing fee increases from 6.07 percent to 6.31 percent. On the other hand, if firm C anticipates early payoff, perhaps in five years, the break-even fee declines to just 4.45 percent, which is still more than the required fee of 3 percent. Even if early repayment is likely or if the spread between the new interest rate and the firm's opportunity cost of capital is not expected to exist over the life of the loan, then refinancing may still be beneficial to the firm.

One could consider cases more complicated than those presented here. Fortunately, most can be solved with a combination of the formulas developed above. For example, suppose one asked: What is the break-even

loan closing fee when the new loan refinances the old and is increased by some amount? One solution to that problem is to treat the addition as a separate loan financed at the market rate of interest for $m_0 n_0$ periods, then use equation G.1 to find the break-even condition for refinancing and changing the term of the old loan. Now the question is reduced to comparing the sum of two loans, both financed at the market rate of interest, with another loan at a different interest rate and solving for the points that would be required for break-even. This example and others suggest a general approach for solving many refinance questions.

Rule of Thumb Test

Finally, consider a test of the refinancing rule of thumb mentioned earlier. The rule states that refinancing should be undertaken when the new interest rate is at least 2 percent less and when savings from monthly payments repay closing fees in three years. To test the rule, we consider an old loan that has an APR of 12 percent, monthly payments for twenty years, and an outstanding balance of \$100,000. The firm's opportunity cost of capital is 8 percent, the marginal tax rate is 28 percent, and 80 percent of the loan fees are tax deductible.

A new loan offers the same terms but with an interest rate of 2 percent less, as suggested by the rule of thumb. The three-year savings guideline implies a break-even loan closing fee of 4.4 percent. By using equation G.1, the break-even fee is really much higher at 13.27 percent. If the borrower were required to pay a 4.4 percent closing fee, the net present value of refinancing would be \$9,017. Therefore, the rule of thumb greatly understates the value of refinancing. With a 4.4 percent loan closing fee, the borrower benefits from refinancing if the interest rate is as high as 11.29 percent.

Conclusions

Lenders report increasing interest from loan customers to refinance, especially as interest rates appear to be poised for future increases. A wide range of refinancing options are available that may trade off loan maturities, interest rates, loan extensions, and loan closing costs.

This paper has examined several refinance alternatives. Break-even and net present value equations for a fixed rate loan have been derived to answer refinance questions. Those equations are recommended to replace rules of thumb often quoted in the popular press.

Most of the derivations in this paper have included the effects of income taxes. It is important to include taxes because interest costs may create tax shields. Moreover, portions of loan closing costs are sometimes tax deductible. Including the tax effects is important because the break-even conditions for refinancing differ depending on whether or not taxes are included.

Obviously, not all important refinancing alternatives have been considered in this paper. For example, break-even refinance conditions could be derived for other types of loans such as fixed principal or balloon payment loans. What has been provided, however, is a methodology that can be applied to the cases not considered, including other types of loans.

References

- Bruss, Bob. "On Real Estate." *Lansing State Journal*, November 30, 1986.
- Lins, David A., and Lindon J. Robison. "Refinancing Agricultural Loans." *AgriFinance*, October 1986, 26 and 55.
- Robison, Lindon J., and William G. Burghardt. *Five Principles for Building Present Value Models and Their Application to Maximum (Minimum) Bid (Sell) Price Models for Land*. Agricultural Economics report no. 442. Michigan State University, November 1983.
- Robison, Lindon J., S.R. Koenig, and J.R. Brake. *An Analysis of Interest and Principal Payments, Interest Rates, and Time in Common and Uncommon Loans Using Present Value Tools*. Agricultural Economics report no. 459. Michigan State University, November 1984.

"Should You Refinance Your Mortgage?" *Reader's Digest*, August 1986, 109-13.

Appendix 1

Notation. This appendix derives two general equations (G.1 and G.2) that provide the

numerical results for this paper's examples. The examples indicate the range of questions that the equations can be used to answer. Notations and definitions used to solve for the two general equations are now introduced; then the equations will be deduced.

The old loan L_o refers to the outstanding dollar amount on an existing loan that is to be financed. Associated with the old loan is its actuarial interest rate of r_o/m_o where: r_o is the annual percentage rate (APR), m_o is the number of loan payments made per year, $m_o n_o$ is the number of payment periods remaining to maturity, and π_o is the outstanding balance of loan closing fees used to close the old loan. The old loan annuity is A_o so that the relationship between the present value of $m_o n_o$ payments of A_o discounted at r_o/m_o is

$$A_o = (L_o + \pi_o) / US_o(r_o/m_o, m_o n_o) \quad (1)$$

where $US_o(r_o/m_o, m_o n_o)$ is an abbreviation used by Robison, Koenig, and Brake for the present value of $m_o n_o$ one dollar payments discounted at the interest rate r_o/m_o . This annuity formula is equal to

$$US_o(r_o/m_o, m_o n_o) = \frac{m_o}{r_o} [1 - (1 + \frac{r_o}{m_o})^{-m_o n_o}] \quad (2)$$

The notation used to describe the terms and amount of the new loan is the same as that used to describe the old loan except that the subscript o is replaced by α which stands for new. For example, r_o/m_o becomes r_α/m_α ; $m_o n_o$ becomes $m_\alpha n_\alpha$; and A_o becomes A_α . If π_α are the fees associated with closing the old loan of $L_o + \pi_o$, the analogous expression for equation 1 only in terms of the new loan is

$$A_\alpha = (L_o + \pi_o + \pi_\alpha) / US_o(r_\alpha/m_\alpha, m_\alpha n_\alpha) \quad (3)$$

To include taxes in our analysis requires that additional notation be defined. Define r to be the borrower's opportunity cost of capital and T the borrower's marginal income tax rate; then the borrower's after-tax opportunity cost of capital is $r(1-T)$. Adjusting annuity payments to their after-tax present values requires the following procedures. First annuity payments must be separated into principal and interest payments. Then interest costs are adjusted to their after-tax equivalent. Finally after-tax annuity payments are discounted by the after-

tax discount rate of $r(1-T)$. Robison and Burghardt (pp. 28, 29) show that the after-tax present value sum of $m_o n_o$ loan payments of one dollar made at the annuity rate of r_o/m_o abbreviated as $US_o T[r_o/m_o, m_o n_o, r(1-T)/m_o]$ is equal to

$$US_o T[r_o/m_o, m_o n_o, r(1-T)/m_o] = (1-T)US_o[r_o(1-T)/m_o, m_o n_o] + T[o] \quad (4)$$

where

$$[o] = \frac{(1 + \frac{r_o}{m_o})^{-m_o n_o} - [1 + \frac{r(1-T)}{m_o}]^{-m_o n_o}}{\frac{r(1-T)}{m_o} - \frac{r_o}{m_o}}$$

There are special tax considerations associated with loan closing costs π_o and π_α . Sometimes only a percentage of the costs δ_o associated with the old loan and δ_α associated with the new loan are allowed to be deducted. Moreover, there may be timing questions as to when the tax deductions associated with $\delta_o \pi_o$ or $\delta_\alpha \pi_\alpha$ may be claimed.

The only other notations, to be defined in more detail later, are $L_{\alpha T}$, the after-tax present value of the new loan $L_o + \pi_o + \pi_\alpha$, and $L_{o T}$, the after-tax present value of the old loan $L_o + \pi_o$, and $t_o \leq m_o n_o$ and $t_\alpha \leq m_\alpha n_\alpha$, the actual number of periods the loan is held before being either refinanced or repaid. To simplify an already complicated analysis, this paper considers only the case where $t_\alpha = t_o = t$.

Deriving general formulas to answer refinancing questions. Using the notation described above and the after-tax present value results obtained by Robison and Burghardt, two general equations (G.1 and G.2) are now derived to answer refinancing questions. The first general equation answers the question: What are the break-even loan closing costs π_α that can be paid so that a borrower is indifferent between continuing with the existing loan or refinancing?

A break-even condition exists when the after-tax present value of the old loan, $L_{o T}$, equals the after-tax present value of the new loan, $L_{\alpha T}$. The new loan is equal to the amount to be refinanced, $L_o + \pi_o$, plus closing costs π_α .

Let the portion of the loan payment that repays loan closing costs be $A_{\alpha\pi}$, which is

related to r_o/m_o , n_o , and $(\pi_o + \pi_a)$ by the expression

$$A_{o\pi} = (\pi_o + \pi_a) / US_o(r_o/m_o, m_o n_o) \quad (5)$$

The after-tax present value of $\pi_o + \pi_a$, π_{oT} , including the δ_a percent deductibility of the principal payments equals

$$\pi_{oT} = A_{o\pi} \{ US_o T [r_o/m_o, m_o n_o, r(1-T)/m_o] - \delta_a T [\alpha] \} \quad (6)$$

where $[\alpha] = [o]$ except that os are replaced with as.

It follows that L_{oT} can be expressed as the after-tax present value of the refinance loan $L_o + \pi_o + \pi_a$ less the tax credit associated with principal payments on loan closing fees. That sum can be written as

$$L_{oT} = A_o US_o T [r_o/m_o, m_o n_o, r(1-T)/m_o] - A_{o\pi} \delta_a T [\alpha] \quad (7)$$

After substituting for A_o and $A_{o\pi}$, (7) can be rewritten as

$$L_{oT} = \frac{(L_o + \pi_o + \pi_a) US_o T [r_o/m_o, m_o n_o, r(1-T)/m_o]}{US_o(r_o/m_o, m_o n_o)} - \frac{(\pi_o + \pi_a) \delta_a T [\alpha]}{US_o(r_o/m_o, m_o n_o)} \quad (8)$$

Following the same procedure, L_{oT} can be expressed as the after-tax present value of the old loan L_o plus π_o less the tax credit associated with principal repayments on loan closing fees. That sum can be written as

$$L_{oT} = A_o US_o T [r_o/m_o, m_o n_o, r(1-T)/m_o] - A_{o\pi} \delta_o T [o] \quad (9)$$

where $A_{o\pi} = \pi_o / US_o(r_o/m_o, m_o n_o)$. After substituting for A_o and $A_{o\pi}$, L_{oT} can be written as

$$L_{oT} = \frac{(L_o + \pi_o) US_o T [r_o/m_o, m_o n_o, r(1-T)/m_o]}{US_o(r_o/m_o, m_o n_o)}$$

$$- \frac{\pi_o \delta_o T [o]}{US_o(r_o/m_o, m_o n_o)} \quad (10)$$

To generalize our calculations involving the after-tax present value of the old and refinanced loan, assume that the new loan and the old loan are to be held for $t \leq (m_o n_o)$ and $(m_o n_o)$ periods. One might ask: What is the after-tax present value of the old and refinanced loans if repaid early?

Let L_{aT}^t be the after-tax present value of the refinanced loan $(L_o + \pi_o)$ plus closing costs π_a if t payments are made on a loan amortized for $m_o n_o$ periods and with the remaining balance paid in full with the t^{th} payment. The outstanding loan balance after t payments according to Robison, Koenig, and Kelsey is $A_a US_o(r_o/m_o, m_o n_o - t)$. To find L_{aT}^t , we discount the outstanding balance and subtract the discounted tax credits from the payment of outstanding loan closing costs. Call the result S^a , which can be expressed as

$$S^a = \frac{[(A_a - \delta_a T A_{a\pi}) US_o(r_o/m_o, m_o n_o - t)]}{[1 + r(1-T)]^t m_a} \quad (11)$$

That allows us to write the after-tax present value of a refinanced loan repaid early, L_{aT}^t , as

$$L_{aT}^t = A_a US_o^t T [r_o/m_o, m_o n_o, r(1-T)/m_a] - A_{a\pi} \delta_a T [\alpha^t] + S^a \quad (12)$$

where

$$US_o^t T [r_o/m_o, m_o n_o, r(1-T)/m_a] = (1-T) US_o[r(1-T)/m_o, t] + T [\alpha^t]$$

and where

$$[\alpha^t] = \frac{(1 + \frac{r_o}{m_a})^{m_o n_o} - (1 + \frac{r_o}{m_a})^{t - m_o n_o} [1 + \frac{r}{m_a} (1-T)]^{-t}}{\frac{r(1-T)}{m_a} - \frac{r_o}{m_a}}$$

The after-tax present value of the old loan if repaid in full in the t^{th} period is now calculated using the same procedure followed to find L_{aT}^t . Using earlier results, the outstanding loan balance on the old loan is $A_o US_o(r_o/m_o, m_o n_o - t) / (1 + r_o/m_o)^{t-1}$.

Discounting the balance less the tax credit from the payment of outstanding loan closing costs equals S^o where

$$S^o = \frac{(A_o - \delta_o T A_{o\pi}) US_o(r_o/m_o, m_o n_o - t)}{(1 + \frac{r(1-T)}{m_o})^t} \quad (13)$$

Having an expression for S^o allows us to write the after-tax present value of the old loan repaid in t periods as L_{oT}^t where

$$L_{oT}^t = A_o US_o^t T[r_o/m_o, m_o n_o, r(1-T)/m_o] - A_{o\pi} \delta_o T[\alpha^t] + S^o \quad (14)$$

and where $[\alpha^t]$ equals $[\alpha^t]$ except that the subscript α is replaced with the subscript o in the expression.

Now we are prepared to calculate our first general equation (G.1) by equating L_{oT}^t and L_{aT}^t and by replacing A_o , $A_{o\pi}$, A_a , and $A_{a\pi}$ with their appropriate expressions. The result is

$$\begin{aligned} \pi_a = & \{ L_{oT}^t US_o(r_a/m_a, m_a n_a) - \\ & (L_o + \pi_o) US_o^t T[r_a/m_a, m_a n_a, r(1-T)/m_a] \\ & + \pi_o \delta_o T[\alpha^t] - [L_o + \pi_o - \delta_o T \pi_o] \\ & US_o(r_a/m_a, m_a n_a - t) [1 + r(1-t)/m_a]^{-t} \} \\ & \div \{ US_o^t T[r_a/m_a, m_a n_a, r(1-T)/m_a] - \delta_o T[\alpha^t] \\ & + (1 - \delta_a T) US_o(r_a, m_a n_a - t) [1 + \frac{r(1-T)}{m_a}]^{-t} \} \end{aligned} \quad (G.1)$$

The second general equation applies when π_a is given as opposed to being solved for as it is in equation G.1. If π_a is given and not equal to the breakeven π_a , then L_{oT}^t will not equal L_{aT}^t and the difference will be the net present value associated with refinancing. The second general equation can be simply written as (G.2) equal to

$$NPV = L_{oT}^t - L_{aT}^t \quad (G.2)$$

Much of the difficulty in repetitive use of (G.1) or (G.2) can be eliminated by using computers. With computers, the formulas can be programmed, as we have done, and solved easily, making them a powerful tool that could replace less precise rules of thumb.

From (G.1) and (G.2) most special refinance formulas can be derived. Indeed (G.1) is only a special case of (G.2) with NPV set equal to zero. Some important special cases might include the following. If the refinanced loan is held to maturity, set t equal to $m_a n_a$. If the new loan is refinanced at the market rate of interest, set r_a equal to r . If $t < m_a n_a$ then the analysis applies to balloon payment loans as well as to fixed payment loans repaid early. If loan closing fees are paid at the initiation of the loan, set π_o equal to zero and $[\alpha^t]$ equal to one. If the maturity on the old loan and the new loan are the same, set $m_a n_a$ equal to $m_o n_o$.

Should it be desired to express π_a as a percentage of the refinanced loan, divide π_a by $(L_o + \pi_o)$. The result is often referred to as points.

Portfolio Theory and Financial Structure: An Application of Equilibrium Analysis

Peter J. Barry and Lindon J. Robison

Abstract

This article applies equilibrium analysis under risk to analyze financial structure at the firm level. In a portfolio theory framework, concepts of business risk, financial risk, and risk balancing are used to evaluate the possible responses in financial structure to changes in a firm's operating environment and in the investor's risk attitude. The results provide general guidelines for implementing portfolio adjustments and show the important linkages between theory and practice in financial responses to risk.

Key words: risk, equilibrium analysis, portfolio theory, financial structure.

Equilibrium analysis under risk evaluates a firm's possible responses to changes in the risk characteristics of its environment. Using the mean-variance (EV) model of portfolio theory, the early developments in this area are attributed to Tobin, Levy, and Adler. In addition, Robison and Barry (1977, 1986) developed a general method based on income and substitution effects for evaluating expected utility maximizing responses to factors that shift an EV efficient set or change the level of risk aversion. In a similar approach—called risk balancing—Gabriel and Baker emphasize an investor's trade-off between business risk and financial risk, subject to a maximum tolerance for risk. Collins extends the Gabriel and Baker framework to cast the risk balancing concept in terms of expected utility maximization. These theoretical advancements have enriched the risk analysis framework and allow more comprehensive financial analyses at the micro level.

Our purpose in this article is to review and assimilate those financial concepts of risk into an applied framework for analyzing financial structure issues at the firm level. The analytical approach combines mathematical and graphical methods with numerical examples to indicate what the insight portfolio theory offers for responding to changes in the important parameters affecting the firm's equilibrium position. Although the assumptions and model specifications are relatively simple, the analysis shows the important linkages between theory and practice in financial responses to risk (Baker, Barry and Baker). Moreover, the results provide general guidelines for implementing appropriate portfolio adjustments.

Portfolio Theory

Portfolio theory has included financial activities by introducing a risk-free asset that can be combined with portfolios of risky assets.¹ Positive and negative holdings of the risk-free asset represent borrowing and lending, respectively, at the risk-free interest rate. Combining the risk-free asset with the portfolios of risky assets enlarges the risk-efficient set, makes it more risk efficient, and under normality yields the separation property in which the investment decision in risky assets is independent of the financing decision involving the desired combination of the risky assets and the risk-free asset (Tobin; Van Horne).

Figure 1 portrays this situation where curve LN is the efficient set (minimum variance for alternative expected returns) of risky assets and i is the risk-free rate of return. The optimal portfolio of risky assets (M) occurs at the tangency point between a straight line drawn from the risk-free rate and risk-efficient set LN . Line ii' becomes the expanded risk-efficient set. The choices along that line involve different combinations of portfolio M and the risk-free asset. To the left of M , the risk efficient set, ii' , contains positive holdings of the risk-free asset and portfolio M , with relative holdings of the risk-free asset increasing as movements occur away from M . It indicates lending at the risk-free rate in combination with portfolio M . To the right of M , the risk-efficient set contains negative holdings of the risk-free asset in combination with M ; the farther from M , the greater are the negative holdings. That indicates borrowing at rate i and leveraging the holdings of portfolio M . The positive slope associated with line ii' indicates that the expected return on portfolio M exceeds the certain return (cost) of the risk-free asset.

In the finance literature the expanded risk-efficient set ii' is called the capital market line (CML). Its equation is found by solving for the risk-return relationship once terms are defined for the risk and expected returns of

portfolio M , the risk-free rate, the returns-to-equity capital, and the relative holdings of the two types of assets. Although the focus here is on financial leveraging (to the right of M), we will consider the entire CML . Moreover, the absolute holdings of portfolio M and the risk-free asset will be standardized to express their relative holdings in proportional terms as P_m and P_i , respectively, where P_i is unrestricted in sign. The relationship between P_m and P_i is $P_m + P_i = 1$ if the risk-free asset is held in a positive (lending) position or $P_m - P_i = 1$ if the risk-free asset is held in a negative (borrowing) position.²

The stochastic rate of return to risky assets is $\tilde{r}_m$ and the expected rate of return is $\bar{r}_m$. Therefore, the expected rate of return to equity, $\bar{r}_e$, is

$$\bar{r}_e = \bar{r}_m P_m + i P_i \quad (1a)$$

for positive holdings of the risk-free assets, and

$$\bar{r}_e = \bar{r}_m P_m - i P_i \quad (1b)$$

for negative holdings of the risk-free assets.

The financial implications of equation 1b are shown by considering $\bar{r}_e$ as an expected rate of return per dollar of equity capital (E) and P_m and P_i as the ratios of risky assets to equity (A/E) and risk-free debt to equity (D/E), respectively, where $A - D = E$. The rate of return to equity then is simply the difference between the rate of return to assets and the cost of debt, each weighted by the proportions of risky assets and risk-free debt in the financial structure of the investor's portfolio.

The variance of the rate of return to equity return is expressed as

$$\sigma_e^2 = \sigma_m^2 P_m^2 \quad (2)$$

and the standard deviation as

$$\sigma_e = \sigma_m P_m \quad (3)$$

²The adjustments in the market portfolio are moderated if the risk efficient set is a discontinuous set of points rather than a monotonic curvilinear function. Then, the stability of the discrete solutions would indicate that parameter values could fluctuate in some range without changing the market portfolio. Indeed, a discontinuous risk-efficient set generally is the case in empirical analysis.

¹The impacts of risky financing activities are considered by Fama; Elton and Gruber; Barry, et al.; and others. A major consequence is the breakdown in the separation property discussed below. Here, however, the assumption of a risk-free financial activity is retained to simplify the equilibrium analysis.

where σ_m is the standard deviation of the rate of return on portfolio M . Thus, the standard deviation of the rate of return on equity is the weighted standard deviation of the rate of return on risky assets.

To find the equation for line ii' in Figure 1, we solve $P_m - P_i = 1$ for $P_i = P_m - 1$ and substitute for P_i in equation 1b. Rearranging terms yields

$$\bar{r}_e = i + (\bar{r}_m - i)P_m \quad (4)$$

Multiplying the numerator and denominator of the second term by σ_m and substituting $\sigma_e = \sigma_m P_m$ in the numerator yields the equation of the *CML*.

$$\bar{r}_e = i + [(\bar{r}_m - i) / \sigma_m] \sigma_e \quad (5)$$

where i and $(\bar{r}_m - i) / \sigma_m$ are the intercept and slope of the *CML*, respectively.

Equation 5 indicates that the expected rate of return to equity of any portfolio along ii' is the sum of the risk-free rate plus a risk premium defined as the price of risk times the quantity of risk. The price of risk is the bracketed term in (5). It gives the margin of excess return $(\bar{r}_m - i)$ per unit of risk (σ_m) for portfolio M . Because the object is to achieve the highest possible return per unit of risk (that is, the highest possible capital market line), portfolio M can be identified among the various portfolios of risky assets because, in combination with the risk-free asset, it yields the highest price of risk. Adding the risk premium to the risk-free rate gives the expected rate of return on equity for any point along the *CML*.

Business Risk and Financial Risk

For financial analysis, it is helpful to distinguish between the effects of business risk and financial risk on the investor's total risk. Business risk arises from the variability of returns to the investor's risky assets. It is independent of the financial structure of the investor's portfolio. Financial risk arises from the composition and terms of the financial claims on the assets. Any fixed-obligation financing, as in borrowing and leasing, is considered a form of financial leveraging; it adds to the investor's financial risk. Together,

business and financial risks combine to determine total risk.

Business and financial risks can be modeled in an additive or multiplicative way. Gabriel and Baker derived an additive relationship between business and financial risk that shows the absolute increase in total risk that is attributed to debt financing. Barry showed a multiplicative approach that is based on the percentage increase in total risk attributed to debt financing. The two approaches are essentially the same, differing only in their measurement concepts.

Following the multiplicative approach, the relationship between total risk (*TR*), business risk (*BR*), and financial risk (*FR*) is defined as

$$TR = (BR) (FR) \quad (6)$$

Suppose, for example, that the investor's portfolio is in equilibrium at point K in Figure 1, as indicated by a tangency between the *CML* and the investor's indifference curve for risk and return. Furthermore, let total risk at K be represented by the ratio of the standard deviation of the rate of return to equity (σ_e) to the expected rate of return to equity ($\bar{r}_e$). The ratio, a coefficient of variation, can be expressed using equations 1 and 3 as

$$TR = \sigma_e / \bar{r}_e = \sigma_m P_m / [\bar{r}_m P_m - i P_i] \quad (7)$$

TR is expressed as the product of business risk (*BR*) and financial risk (*FR*) by first defining business risk as the ratio of σ_m and $\bar{r}_m$, the coefficient of variation for returns on the risky assets

$$BR = \sigma_m / \bar{r}_m \quad (8)$$

Financial risk then is found by dividing total risk in equation 7 by business risk in equation 8, so that (Barry)

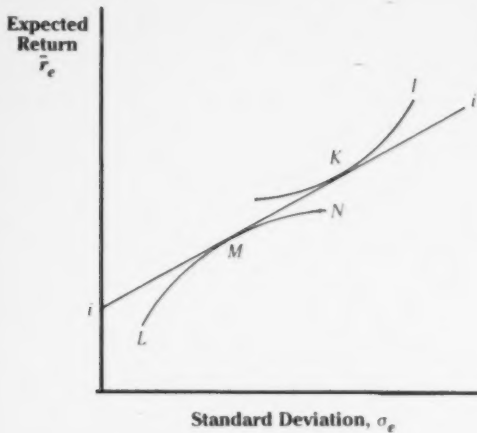
$$FR = \bar{r}_m P_m / [\bar{r}_m P_m - i P_i] \quad (9)$$

Multiplying (8) by (9) yields

$$TR = [\sigma_m / \bar{r}_m] [\bar{r}_m P_m / (\bar{r}_m P_m - i P_i)] \quad (10)$$

The expression for financial risk is another indicator of the level of financial leverage in the investor's portfolio. Equation 9 relates the

Figure 1. Risk Efficient Set



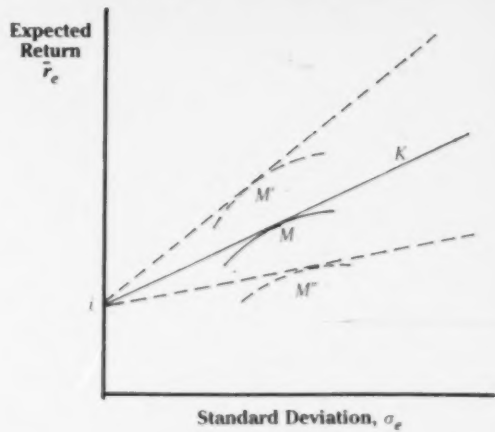
return on risky assets in the numerator to the return on equity in the denominator. This flow measure of leverage is analogous to a stock measure expressed by the asset-to-equity ratio in which total assets are related to the equity claims on the assets. As the stock measures of leverage increase (that is, higher P_m and P_i), so does the measure of financial risk in (9). Moreover, for a constant BR , total risk increases as well.

Equilibrium Analysis and Portfolio Changes

Equation 10 can be evaluated in terms of possible adjustments in BR , FR , or both as changes occur in one or more of the model's parameters. If, for example, the investor's risk attitude were expressed by a constant level of TR , then an increase (decrease) in BR may be offset by a decrease (increase) in FR . Or, an increase in FR —due perhaps to higher borrowing costs—could be offset by managerial or policy actions that result in a reduction in BR . Even if the risk attitude changes so that a new TR is preferred, trade-offs between BR and FR still may occur in restoring equilibrium as parameters change.

The effects of changes in parameter values on the location of the CML are illustrated in Figures 2 and 3, where K is the initial equilibrium position. Changes in P_m and P_i occur as movements along the CML . Increases in $\bar{r}_m$ and σ_m rotate the CML

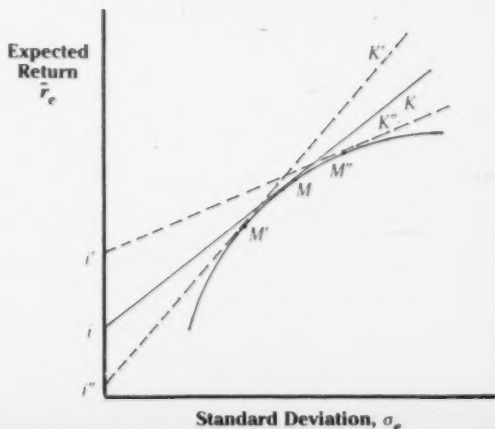
Figure 2. Shift in Risk Efficient Set for a Change in Expected Return or Variance of Risky Assets



upward and downward, respectively, around point i on the vertical axis (Figure 2). Decreases in $\bar{r}_m$ and σ_m have the opposite effects. An increase in the risk-free rate i has the dual effects of shifting the CML upward and reducing its slope (Figure 3). A decrease in the risk-free rate shifts the CML downward and increases its slope.

For each change in the CML , the original portfolio becomes nonoptimal, and portfolio adjustments are needed to restore equilibrium. The changes may involve offsetting responses in business risk and

Figure 3. Shift in Risk-Efficient Set from a Change in the Risk-Free Rate



financial risk, depending on the types of options that are available. To illustrate, when $P_m > 1$, an increase in the risk-free rate from i to i' in Figure 3 should ultimately result in lower financial leverage and thus lower FR . However, the increase in i also brings a new, riskier market portfolio M'' to be offset by a reduction in leverage. Similarly, increases in the variances of risky assets or reductions in their expected returns also bring changes in the market portfolio in Figure 2.

The portfolio responses are analyzed more precisely by mathematically expressing the equilibrium framework and exploring how the risky and risk-free assets respond to changes in the various decision parameters. Especially important is the response of the investor's risk attitude to changes in the object of his or her utility function. In the next subsection the portfolio framework is expressed in a mathematical form in order to establish an initial equilibrium (that is, point K in the figures) and to show the equilibrium responses to various parameter changes. Following that, the equilibrium framework is numerically illustrated by changes in BR , FR , and the investor's financial structure.

Defining the Equilibrium Position

The investor is assumed to maximize, as a decision criterion, the expected utility of end-of-period wealth

$$\text{Max } EU(E_I) \quad (11)$$

where $E_I = (1 + \tilde{r}_e) E_o$ and $\tilde{r}_e$ is the stochastic return on equity. Using the mean-variance framework and expressing the risk-return trade-off by λ , the objective function can be expressed as

$$\text{Max } Y_{CE} = E(E_I) - (\lambda/2) \sigma^2(E_I) \quad (12)$$

where Y_{CE} is the certainty equivalent of the selected portfolio, and $E(E_I)$ and $\sigma^2(E_I)$ are the expected value and variance, respectively, of the investor's end-of-period equity capital.³

³Tobin pointed out that all choices in a portfolio problem consisting of combinations of a risky and risk-free asset will always be mean-variance (EV) efficient. Thus, consistency between EV and EU models is assured in this context. Meyer generalized Tobin's observations by pointing out that the condition is also satisfied when the assets satisfy a location parameter consistency condition. Because both Meyer's and Tobin's sufficiency conditions are satisfied here, a maximizing certainty equivalent expression can be formulated that is consistent with any particular EU maximizing choice (Robinson and Barry 1986).

Furthermore, let the expected value of E_I be the end-of-period equity where $\bar{r}_m$ is the expected value of the random variable $\tilde{r}_m$. Then $E(E_I)$ can be expressed as

$$\begin{aligned} E(E_I) &= E[(1 + \tilde{r}_m)(D_o + E_o)] \\ &= (1 + i)D_o \\ &= (\bar{r}_m - i)D_o + (1 + \bar{r}_m)E_o \end{aligned} \quad (13)$$

where D_o and E_o are the beginning levels of debt and equity, respectively.

The variance of E_I is

$$\sigma^2(E_I) = (D_o + E_o)^2 \sigma_m^2 \quad (14)$$

Substituting (13) and (14) into (12) yields

$$\begin{aligned} \text{Max } Y_{CE} &= (\bar{r}_m - i)D_o + (1 + \bar{r}_m)E_o \\ &\quad - \lambda/2 (D_o + E_o)^2 \sigma_m^2 \end{aligned} \quad (15)$$

which provides the same solution as (11) for a given λ and an exponential form of the utility function. Dividing equation 15 by the constant E_o does not affect the solution for D_o and puts the maximizing expression into the form of the portfolio problem where P_m and P_i are the ratios of risky assets and debt to equity, respectively.

$$\begin{aligned} \text{Max } Y_{CE}^* &= 1 + \bar{r}_m P_m - i P_i \\ &\quad - \lambda/2 E_o P_m^2 \sigma_m^2 \end{aligned} \quad (16)$$

where $Y_{CE}^* = Y_{CE}/E_o$. Using equations 1 and 2 an alternative to (16) is

$$\text{Max } Y_{CE}^* = 1 + \bar{r}_e - \lambda/2 E_o \sigma_e^2 \quad (17)$$

The certainty equivalent expression in (17) is interpreted as one plus the expected rate of return on equity minus a risk premium the investor would pay to receive $\bar{r}_e$ with certainty.

Under various interpretations λ is considered equal to a local approximation of the coefficient of absolute risk aversion. That is,

$$\lambda = [-U''(E_I)] / [U'(E_I)]$$

Because $U(E_I)$ is defined as the utility of end-of-period equity capital, the values of λ are associated with absolute levels of wealth. However, expressions 16 and 17 have been converted to account for the expected value and variance of a rate of return so that the expected utility maximizing solution involves

$$EU(E_I/E_o) \quad (18)$$

Table 1. Effects on Risk Attitudes of Factors Affecting the Location of the Capital Market Line

Risk Attitude	Favorable Capital Market Line Effects	Unfavorable Capital Market Line Effects
Decreasing Absolute Risk Aversion	$\partial\lambda/\partial(\cdot) < 0$	$\partial\lambda/\partial(\cdot) > 0$
Constant Absolute Risk Aversion	$\partial\lambda/\partial(\cdot) = 0$	$\partial\lambda/\partial(\cdot) = 0$
Increasing Absolute Risk Aversion	$\partial\lambda/\partial(\cdot) > 0$	$\partial\lambda/\partial(\cdot) < 0$

Thus, λ represents the coefficient of absolute risk aversion scaled by the parameter E_o . That is,

$$\lambda = [-U''(E_i)E_o] / [U'(E_i)]$$

To find the optimal P_m we substitute $P_m - 1$ for P_i in (16), differentiate with respect to P_m , and solve for P_m

$$P_m = (\bar{r}_m - i) / (\lambda E_o \sigma_m^2) \quad (19)$$

The certainty equivalent solution is consistent with the results of the expected utility model, given the assumed model specifications. The quadratic nature of the expression ensures that the second order conditions are satisfied. As above, $P_m > 1$ implies a borrowing situation and $P_m < 1$ implies lending. The particular financial position is determined by the difference $(\bar{r}_m - i)$ between the rate of return on risky assets and the risk-free rate, relative to the value of the denominator in (19).

Equilibrium analysis considers the response of P_m to changes in its determining factors (λ , $\bar{r}_m$, E_o , i , and σ_m^2), which in turn affect the location of the CML. But, the risk attitude, λ , itself is a function of the model's parameters as indicated by the concepts of decreasing absolute risk aversion (DARA), constant absolute risk aversion (CARA), and increasing absolute risk aversion (IARA) (Robison and Barry 1986; Pratt). It is commonly believed, for example, that investors are willing to accept greater amounts of risk (DARA) as their wealth increases. Thus, the responses of λ to changes in the parameters are an important component of the equilibrium conditions.

Using results from Cass and Stiglitz, Robison and Barry (1986) derive the results in Table 1 showing the responses of risk attitudes to events causing favorable versus unfavorable

effects on an investor's capital market line. For example, the risk attitude response to an increase in $\bar{r}_m$ (a favorable event) is $\partial\lambda/\partial\bar{r}_m$ is less than, equal to, and greater than zero for DARA, CARA and IARA, respectively. A decline in $\bar{r}_m$ has the opposite effects.

The risk attitude response determines the income effect, which combines with the substitution effect under risk to determine the total response of P_m to a change in one of its determinants (Robison and Barry 1977, 1986). A change in P_m resulting from a parameter change, while holding λ constant, indicates the substitution effect under risk. The response of P_m to a change in λ indicates the income effect. The total response is the sum of the substitution and income effects, where the latter includes the risk attitude response.

For a change in $\bar{r}_m$, the results are

$$dP_m / d\bar{r}_m = [1 / (\lambda E_o \sigma_m^2)] - [(\bar{r}_m - i) / (\lambda^2 E_o \sigma_m^2)] [\partial\lambda/\partial\bar{r}_m] \quad (20)$$

The first term is the substitution effect, and the second is the income effect. Because $\partial\lambda/\partial\bar{r}_m \leq 0$ for DARA and CARA, respectively, then $dP_m/d\bar{r}_m \geq 0$ for these risk attitudes, where $\bar{r}_m - i > 0$, and the result is ambiguous for IARA.

For a change in the initial equity capital, the results are

$$dP_m / dE_o = -(\bar{r}_m - i) / (\lambda E_o^2 \sigma_m^2) - [(\bar{r}_m - i) / (\lambda^2 E_o \sigma_m^2)] [\partial\lambda/\partial E_o] \quad (21)$$

Because $\partial\lambda/\partial E_o \geq 0$ for CARA and IARA, P_m decreases with an increase in E_o , where $\bar{r}_m - i > 0$. For DARA, however, the holdings of risky assets will increase as E_o increases, leaving the sign of dP_m/dE_o ambiguous.

Table 2. Portfolio Results Along the Capital Market Line

Portfolio	Proportions ^{a/}		Expected Return, $\bar{r}_e$	Risk, σ_e	Coefficient of $\sigma_e/\bar{r}_e$	Risk Premium $\left[\frac{\bar{r}_m - i}{\sigma_m} \right] \sigma_e$
	P_m	P_f				
1	0	-1	.12	0	0	0
2	.5	-.5	.14	.03	.21	.02
3	1	0	.16	.06	.38	.04
4	2	1	.20	.12	.60	.08
5	3	2	.24	.18	.75	.12
6	4	3	.28	.24	.86	.16

^{a/} $P_m + P_f = 1$

For a change in the risk-free rate, the results are

$$\frac{dP_m}{di} = -1 / \left(\lambda E_o \sigma_m^2 \right) - \left[\frac{(\bar{r}_m - i) / (\lambda E_o \sigma_m^2)}{\partial \lambda / \partial i} \right] \quad (22)$$

The substitution effect is unambiguously negative, but the conditions under which the income effect also yields unambiguous results must be established. For a borrower ($P_m > 1$), an increase in i yields the opposite effects on P_m of an increase in $\bar{r}_m$. For DARA and CARA, $\partial \lambda / \partial i \geq 0$, because an increase in i diminishes the borrower's financial position. Thus $dP_m/di < 0$. The income and substitution effects have the same sign so that dP_m/di is unambiguously negative; that is, the ratio of risky assets to equity decreases as i increases for the risk attitudes.

For a lender ($P_m < 1$), the response to a change in the risk-free rate is $dP_m/di < 0$ for IARA and CARA, but the result is ambiguous for DARA. The unambiguous results occur because $\partial \lambda / \partial i \geq 0$ for IARA and CARA. In financial terms, an increase in the risk-free rate under lending creates an incentive to purchase fewer risky assets for IARA and CARA, or for CARA, to not increase holdings of the risky assets.

The remaining result is the response of P_m to an increase in σ_m^2 . The result is the opposite response to an increase in $\bar{r}_m$; thus it is not considered further.

Numerical Analysis

The relationships are demonstrated by numerically specifying the variables and applying equilibrium analysis under risk. That approach uses equation 19 to find the optimal portfolio and then considers the

possible responses to parameter changes in terms of the balancing concepts for business risk and financial risk. Moreover the possible changes are generalized beyond the comparative static framework, where all but one parameter are held constant, to allow changes in more than one of the parameters to restore equilibrium.

To begin, let portfolio M be given with parameters $\bar{r}_m = .16$ and $\sigma_m = .06$, and let the risk-free rate be $i = .12$. That yields an equation for the CML of $\bar{r}_e = .12 + .67\sigma_e$. The risk and return measures for various points along the CML are found by ranging P_i in one unit intervals from 1 to 3. The results are shown in Table 2. Expected returns and risk (σ_e) both increase as P_i increases, consistent with the notion that greater financial leverage increases expected returns and risk as long as $\bar{r}_m$ exceeds i . Moreover, risk increases at the faster rate, as indicated by the increasing coefficients of variation for total risk, and the risk premium increases in a linear fashion consistent with the slope of the CML.

Next, let portfolio 4 be the investor's initial equilibrium position (K). In terms of equation 19 portfolio 4 has a ratio of risky assets to equity of $P_m = 2$, which, for the other parameters given above, is consistent with a risk aversion coefficient of $\lambda = .0000055$. As Table 2 shows, portfolio 4 has ratios of assets to equity and debt to equity of 2 and 1, respectively, an expected return to equity of .2, and a standard deviation of .12. Business risk (BR) has a value of .375 ($= .06 / .16$) and financial risk has a value of 1.6 $= (.16) (2) / [(.16) (1) - (.12) (1)]$. Total risk then is $TR = .6 = (.375) (1.6)$, which is the coefficient of variation for returns to equity.

In equilibrium that measure of TR represents the preferred relationship between the expected value and the standard deviation of returns to equity capital. It is the target measure in response to the parameter changes, subject to no change in the investor's risk attitude. The parameters subject to change include the expected return and standard deviation of risky assets and the risk-free cost of borrowing. In addition changes in asset values and other events beyond the investor's control could alter leverage and thus trigger compensating responses by the investor. Finally, the investor's risk aversion could also change, resulting in a new preference level for TR .

An increase in the risk-free interest rate would increase financial risk and thus increase total risk to an unacceptable level. One set of options for responding involves actions to reduce financial risk, either by reductions in leverage, seeking lower cost financing, or both. A second set of options involves actions to reduce business risk, either through a lower σ_m , a higher $\bar{r}_m$, or both. A third option could involve a combination of actions affecting both business risk and financial risk.

To illustrate the changes, we let the risk-free interest rate increase from .12 to .14. As a result TR increases from the equilibrium value of .6 to

$$\begin{aligned} TR &= (.06 / .16) [(.16) (2)] / [(.16) (2) \\ &\quad - (.14) (1)] \\ &= (.375) (1.78) \\ &= .667 \end{aligned}$$

The investor must identify and evaluate a set of actions that restore TR to its equilibrium value of .6. Following the categories indicated above, one approach is to reduce business risk from .375 to

$$BR = TR / FR = .6 / 1.78 = .337$$

Because $BR = \sigma_m / \bar{r}_m$, the reduction could occur either by reducing σ_m to .054 = (.337) (.16), or by increasing $\bar{r}_m$ to .17, or by combining a reduction in σ_m with an increase in $\bar{r}_m$.⁴ The actions to implement

those changes would involve adjustments in the risk-return relationships of the firm's risky assets, perhaps by using additional production and/or marketing responses to risk, to new public programs, or by seeking further improvements in production efficiency. However, the feasibility of those approaches may be limited if the investment plans are already on the efficiency frontier.

A second approach to restoring equilibrium is to change the level of financial leverage so that financial risk returns to its original level. That approach involves solving for levels of P_m and P_i that satisfy

$$FR = (.16 P_m) / (.16 P_m - .14 P_i) = 1.6$$

Substituting $1 + P_i$ for P_m and solving for P_i yields $P_i = .75$. Thus, equilibrium could be restored by reducing the debt-to-equity ratio from 1 to .75, and, thus, the asset-to-equity ratio from 2 to 1.75.

Next let a change in the investor's risk environment increase the standard deviation on risky assets from $\sigma_m = .06$ to $\sigma_m = .08$. Business risk increases so that, when combined with financial risk, total risk increases to

$$\begin{aligned} TR &= (.08 / .16) [(.16) (2)] / [(.16) (2) - \\ &\quad (.12) (1)] \\ &= (.5) (1.6) \\ &= .8 \end{aligned}$$

As above, the options for reestablishing $TR = .6$ include reductions in financial leverage, lower cost financing, and/or reductions in business risk. Holding other factors constant, reducing the debt-to-equity ratio from 1 to .286 would achieve the target for TR ; or, the risk-free borrowing rate could be reduced to $i = .053$; or, the rate of return on assets could be increased to $\bar{r}_m = .193$. Or, a combination of those changes could occur. Suppose, for example, that in response to the greater risk (σ_m), the availability of a new public program reduces the borrowing cost to $i = .1$ and other policy responses increase the expected return on risky assets to $\bar{r}_m = .17$. Under those conditions, equilibrium could be restored by reducing the debt-to-equity ratio from 1 to .578. Finally, suppose that the investor's risk attitude changes so that an

⁴The revised value of $\bar{r}_m$ is found by solving the following expression for $\bar{r}_m$: $TR = .6 = (.06 / \bar{r}_m) \{ [(\bar{r}_m) (2)] / [\bar{r}_m (2) - (.14) (1)] \}$

increase in σ_m reduces the equilibrium value of TR to .55. For $\sigma_m = .08$, $\bar{r}_m = .17$, and $i = .1$, the debt-to-equity ratio would need to decline to .325 in order to satisfy $TR = .55$. Other changes in parameter values could be evaluated in a similar fashion.

Implications and Concluding Comments

As the preceding comparative statics and numerical examples have shown, extending equilibrium analysis from the certainty case to conditions of risk provides a useful framework for identifying and appraising the possible changes in financial structure that an investor may consider in responding to important changes in the operating environment. The framework can account for changes in the major financial variables (leverage, interest rates, risk, and returns on assets) and for changes in the investor's risk attitude. The specific form and magnitude of the portfolio adjustments will vary with the structural and operating characteristics of the decision unit involved, with the attitudinal characteristics of the investor, and with the possible responses of lenders and other financial claimants. However, the analytical framework provides an enriched information base for developing general guidelines to consider in approaching the adjustment process. In particular, the distinction between business risk and financial risk enables an analyst to gauge the magnitudes of changes in BR and/or FR that are needed to restore an equilibrium level of TR , and thus assess the feasibility of accomplishing those changes with the managerial and policy instruments that are available.

The theoretical analysis also highlights the importance of financial responses to risk as represented by the adjustments in financial leverage and, thus, financial risk. In practice those adjustments include the management of repayment obligations, the maintenance and use of credit reserves, debt restructuring alternatives, and revisions in targets on leverage to fit the characteristics of different farm businesses. These responses are commonly observed among farmers who utilize borrowed funds and are considered highly effective risk responses (Patrick, et al.).

developed here might consider uncertain borrowing costs, more general concepts of risk, and imperfections in financial markets that create a spread between borrowing and lending rates. Barry, et al., show, for example, how unanticipated changes in interest rates and credit availability may influence optimal debt levels for given levels of equity, with the correlation between the returns on assets and the cost of borrowing having an important effect. Wilson and Gunderson also consider a broader concept of risk in which the overall shape of the distribution of returns for risky assets may be important. Finally, Robison and Barry (1986) explore the consequences for borrowing behavior of introducing liquidation costs on assets, credit limits, and liquidity requirements. The implications of those factors for applied financial analysis merit consideration in future studies.

References

- Adler, M.A. "On the Risk-Return Trade-Off in the Valuation of Assets." *J. of Fin. and Quant. Analysis* 4(1969):493-512.
- Baker, C.B. "Credit in the Production: Organization of the Firm." *Amer. J. of Agr. Econ.* 49(1968):507-21.
- Barry, P.J. "Financing Growth and Adjustment of Farm Firms Under Risk and Inflation." In *Modeling Farm Decisions for Policy Analysis*, edited by K.H. Baum and L.P. Schertz. Boulder: Westview Press, 1983.
- Barry, P.J., C.B. Baker, and L.R. Sanint. "Farmers' Credit Risks and Liquidity Management." *Amer. J. of Agr. Econ.* 63(1981):216-27.
- Barry, P.J., and C.B. Baker. "Financial Responses to Risk in Agriculture." In *Risk Management in Agriculture*, edited by Peter J. Barry. Ames: Iowa State University Press, 1984.
- Cass, D., and J.E. Stiglitz. "Risk Aversion and Wealth Effects on Portfolio with Many Assets." *Rev. of Econ. Studies* 39(1972):331-54.
- Collins, R.A. "Expected Utility, Debt-Equity Structure, and Risk Balancing." *Amer. J. of Agr. Econ.* 67(1985):627-29.
- Fama, E.T. *Foundation of Finance*. New York: Basic Books, 1976.
- Elton, E., and M. Gruber. *Modern Portfolio*

Theory and Investment Analysis. New York: John Wiley, 1981.

Gabriel, S.C., and C.B. Baker. "Concepts of Business and Financial Risk." *Amer. J. of Agr. Econ.* 62(1980):560-64.

Levy, H. "The Demand for Assets Under Conditions of Risk." *J. of Fin.* 38(1973):79-96.

Meyer, J. *Two Moment Decision Models and Expected Utility Maximization*. Michigan State University, Department of Economics, September 1985. Photocopied.

Patrick, G.F., P.N. Wilson, P.J. Barry, W.G. Boggess, and D.L. Young. "Risk Perceptions and Management Responses: Producer-Generated Hypothesis for Risk Modeling." *S. J. of Agr. Econ.* 17 (December 1985):231-38.

Pratt, J. "Risk Aversion in the Small and in the Large." *Econometrica* 32(1964):122-36.

Robison, L.J., and P.J. Barry. "Portfolio Adjustments: An Application to Rural Banking." *Amer. J. of Agr. Econ.* 59(1977):311-20.

_____. *The Competitive Firm's Response to Risk*. New York: MacMillan Company, 1986.

Tobin, J. "Liquidity Preferences as Behavior Toward Risk." *Rev. of Econ. Studies* 24(1958):65-86.

Van Horne, J.C. *Financial Management and Policy*. 6th ed. Englewood Cliffs: Prentice Hall, 1983.

Wilson, P.N., and C.E. Gunderson. "Financial Risk in Cotton Production." *S. J. of Agr. Econ.* 17 (December 1985):199-206.

Guidelines for Submitting Manuscripts

We invite submission of manuscripts in agricultural finance, including methodological, empirical, historical, policy, or review-oriented works. Papers must be original in content. Submissions will be reviewed by agricultural finance professionals. The final decision of publication will be made by the editors.

State in a cover letter why the manuscript would interest readers of the *Review* and indicate whether the material has been published elsewhere. Please prepare manuscripts to conform to the following outline.

Title. Short and to the point, preferably not more than seven or eight words.

Abstract. No more than 100 words.

Key Words. Indicate main topics of the article.

Author's Affiliation. Institutional affiliation appears as a footnote at the bottom of the first page of the article.

Specifications. Manuscript should not exceed 25 pages of typewritten, double-spaced material including tables, footnotes, and references. Put tables and figures on separate pages. Provide camera ready art for figures. Number footnotes consecutively throughout the manuscript and type them on a separate sheet. Margins should be a minimum of one inch on all sides. Please number pages.

References. List alphabetically by author's last name. Include only sources that are referred to in the article. Within the body of the article, references to these sources should state the author's last name (year of publication only if two or more publications are cited by same author) and placed in parentheses.

Procedure. Submit three typewritten copies to the editor. After the manuscript has been reviewed, the editor will return review copies to the author with a letter stating whether the article is accepted, rejected, or needs additional revision.

Published articles will be subject to a page charge of \$40 per printed page. If an author has no financial support from an employer or agency, an exemption from page charge may be petitioned.

Submit manuscripts to John R. Brake, editor, *Agricultural Finance Review*, 157 Warren Hall, Cornell University, Ithaca, New York 14853-7801.

Agricultural Finance Review
157 Warren Hall
Cornell University
Ithaca, New York 14853-7801

Nonprofit O
U.S. Postag
PAID
Cornell
University

Congressional
Inf. Serv/SRI
4520 East West Highway
Bethesda, MD 20814

ISSN 0002